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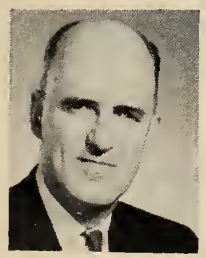
MEET THE AUTHORS

R. G. Griffith, M.E.I.C. Chief engineer of the Canadian Overseas Telecommunication Corporation, Montreal. Graduated from the Institution of Electrical Engineers in Britain in 1924; he joined All America Cables Inc. the same year, and was made development engineer in 1927; transferred to Creed & Co. in 1929, becoming assistant chief engineer, 1935; later joined Cable and Wireless Ltd., London, and was appointed chief engineer, London Communication Centre, in 1946; he came to Canada in 1951, joining the COTC as chief engineer in May, 1954. During the Second World War Mr. Griffith was seconded to the British Foreign Office and took charge of special secret telegraph machine cypher development; he has some 60 patents relating to telecommunications. *(Recent Expansion of Canadian Overseas Telecommunication Facilities.)*

J. N. Ford, M.E.I.C. (left, below). Manager of operations, Canadian Utilities Limited, Edmonton. Graduated in electrical engineering from University of Alberta in 1934; before joining Canadian Utilities Limited as chief electrical engineer in 1951 was employed in Saskatchewan, Alberta and Newfoundland in the field of electrical transmission and distribution engineering; member of Association of Professional Engineers of Alberta, Canadian Electrical Association, and Northwest Electric Light and Power Association. *(Battle River Steam Station.)*



W. I. McFarland, M.E.I.C. (right, above). Partner, Haddin, Davis & Brown Limited, Calgary. Graduated in electrical engineering from the University of Alberta in 1929; took portion of student training course with Canadian Westinghouse from graduation to 1930; from that date to the end of 1935 was assistant to the electrical engineer at Beauharnois during construction of the first power development at that site; from 1936 to December 1952 he was with the City of Edmonton in various positions: electrical engineer with light and power department, electrical engineer with power plant and water treatment plant department, electrical engineer and assistant superintendent of transit system, superintendent of power plant and water treatment plant department. *(Battle River Steam Station.)*

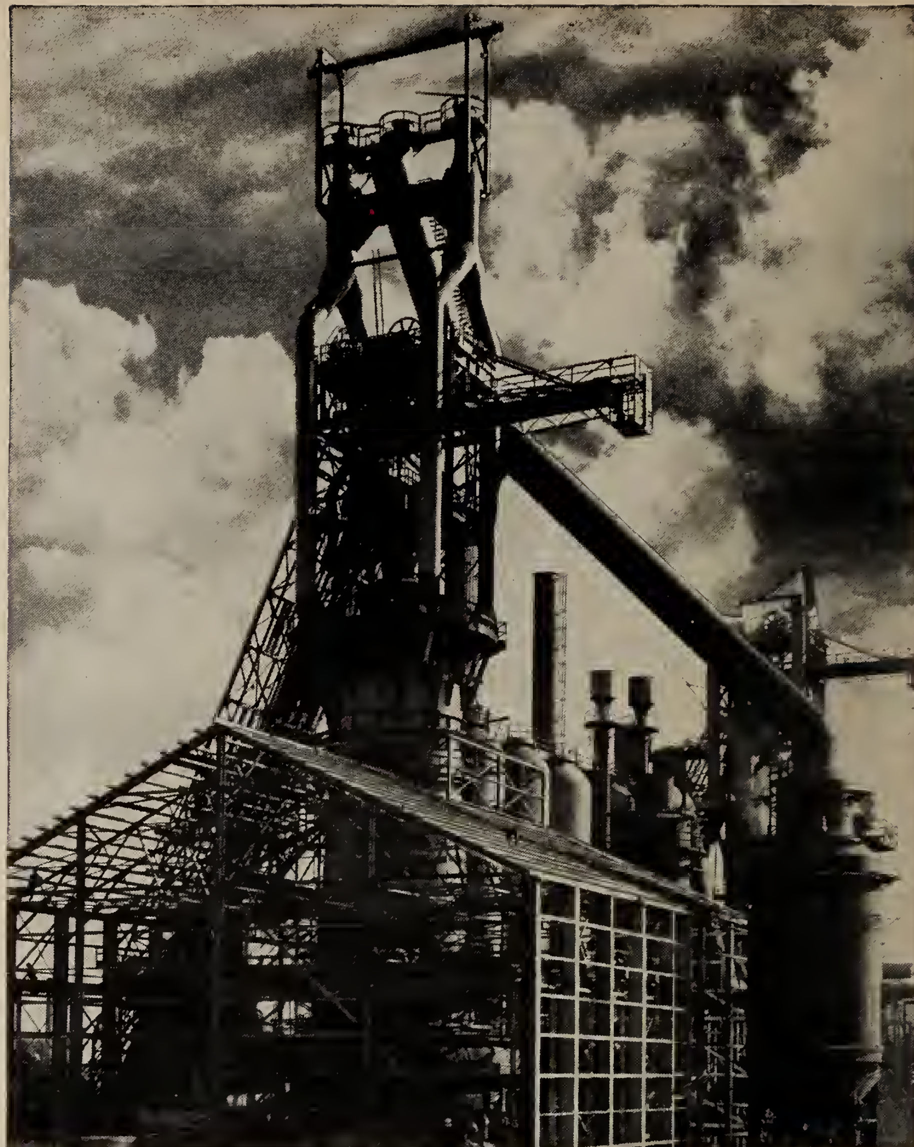
R. J. Kennedy, M.E.I.C. Associate professor of civil engineering, Queen's University, Kingston; attended Queen's University 1937/1941 (medal in civil engineering); RCE, Canada, England, N.W. Europe, 1941/1946 (awarded Military Cross at Arnhem); on staff at Queen's University 1946/1948; student at State University of Iowa 1948/1949 (J. Waldo Smith Hydraulic Fellowship of ASCE); Queen's University staff 1949 to date; supervisor, Pulp and Paper Research Institute of Canada, for project RC-12 since 1952. *(Forces Involved in Pulpwood Holding Grounds.)*

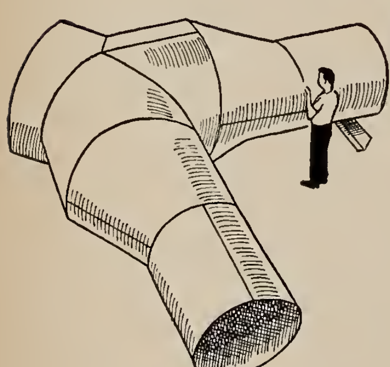
H. R. L. Streight. Principal chemical engineer, Du Pont Company of Canada (1956) Limited. Attended the University of British Columbia (B.A. and later M.A.); proceeded to England on an 1851 Exhibition scholarship, attended Birmingham and Oxford Universities (Ph.D., Birmingham). Spent some time with Imperial Chemical Industries in England; transferred to Canadian Industries Limited in 1937 and on its division into two companies in 1954 became a member of Du Pont of Canada's engineering department; he is a former director of The Chemical Institute of Canada; past chairman, chemical engineering subject division, C.I.C.; ex-member of the editorial board of *Chemistry in Canada*, and current member of the editorial board of *Canadian Journal of Chemical Engineering*. He will be conference chairman of the April, 1958, combined meeting in Montreal of the American Institute of Chemical Engineers and Chemical Institute of Canada. *(Air Pollution Control at a Nylon Intermediates Plant.)*

COVER PICTURE

The cover picture this month symbolizes a subject that is very much to the forefront in the daily news and in technical discussion. It is a view of a missile undergoing the low-temperature tests which form part of the customary rigorous testing program.

Photo: Canadian Westinghouse Limited





Recent Expansion of Canadian Overseas Telecommunication Facilities

R. G. Griffith, M.E.I.C.

Chief Engineer, Canadian Overseas Telecommunication Corporation.

Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June, 1957.

IN THIS PRESENT day world, in which electronics, automation and nuclear science are an every day topic, we rarely pause to remember that it is but a few centuries back when the only means known to man of signalling the approach of an invader was by bonfires, and that it took centuries to develop from this form of communication to the semaphore, such as was used to signal the defeat of Napoleon at Waterloo. Also, that it required nearly the passage of another quarter century before the electric telegraphy was born. It is a startling fact that it is only little more than a 100 years since the first telegraph cable was laid in the sea.

During the last half of the 19th century, and the beginning of the 20th century, most of the world's submarine telegraph cables were laid, among the most noteworthy of these being the first trans-Atlantic telegraph cable, laid between Newfoundland and the British Isles in 1858; the second being the longest submarine cable in the world, involving a distance of 3,460 nautical miles, between Vancouver Island and Fanning Island, which was laid in 1902 as a joint enterprise by Canada, New Zealand, Australia and Great Britain.

At the beginning of the 20th century, radio telegraphy enters the historic picture, and reference must be made to the night of December 12th/13th, 1901, when on Signal Hill, Newfoundland, Marconi heard radio signals that had traversed the Atlantic. By 1926, with the construction of what was then termed the short wave beam radio stations at Yamachiche and Drummondville, in Quebec Province, radio communication took a great step forward.

Although numerous technical improvements have been made, both in respect of cable and radio, overseas telephone and telegraph technique, equipment and plant, which in the aggregate represent substantial progress, no further startling advance in the long distance overseas telecommunication field was made until the laying of the first Transatlantic telephone cable, which was completed in the fall of 1956. The successful completion of the installation of this first cable marks an important era in overseas telecommunications. It is even more interesting because this epoch-making advance comes into phase with the rapid development of Canada, which demands the improved inter-Continental telephone facilities that can now be made available, and it is worthy of note that with practically every leading step in the development of trans-oceanic telecommunications, Canada has been well in the picture.

Co-ordinated with the provision of the first Transatlantic telephone cable, increased communication facilities have been provided for operation between Canada and Australasia and the Far East. The main object of this paper is to survey these new facilities and to extemporise on the possible trend of future development.

In 1950 the Canadian Government established a Crown Company to provide and co-ordinate Canadian overseas telecommunication facilities. The nucleus of this Crown Company was that part of the global communication system of Cable and Wireless Limited, existing within Canadian boundaries, and this paper sets out to present a picture of the expansion of these Canadian facilities, effected during the last few years. It also indicates that, owing to the fact that at present the Commonwealth network passes through the Suez Canal area and other troublesome spots, the future might find Canada playing a much greater part in Commonwealth telecommunications. The paper also briefly refers to future trends in the development of trans-oceanic submarine telephone cables.

The First Transatlantic Telephone Cable

The first Transatlantic telephone cable has been the subject matter of a number of previous papers; even so, it is considered appropriate to include reference to salient points likely to be of general interest.

The Atlantic telephone cable project was the outcome of a joint enterprise by the American Telephone and Telegraph Company, the British Post Office, and the Canadian Overseas Telecommunication Corporation, the conditions of which partnership were embodied in a tri-partite agreement which was signed on November 27th, 1953. The cable system was to provide a two directional transmission bandwidth of 26 kc/s. for Canadian, and 118 kc/s. for American circuits. The agreement also provided for the Eastern Telephone and Telegraph Company of Canada to take over the

American Telephone and Telegraph interests in the Canadian section of the system.

This undertaking to lay a Transatlantic telephone cable across the sea involving the placing in deep water of more than one hundred repeaters, was a very bold venture; however the successful completion of the project was a very reasonable expectation, for considerable wealth of experience and "know-how" had been collected over many years in submarine cable practice, electronic repeater technique, and with methods of the manufacturing of substantially trouble-free components.

The decision to lay a telephone cable across the Atlantic immediately raised a number of matters that had to be correlated in order to arrive at the first stage of system planning, most important of which was the decision as to the actual cable route. The route was finally selected as shown in Fig. 1, which is north of the many telegraph submarine cables, which have been laid during the past 100 years.

Owing to the combining of American and British technical philosophy within the one system, the Sydney Mines/Clarenville section conforms to British practice and is therefore a single cable having two-directional repeaters, whereas the Clarenville/Oban section in accordance with American practice comprises two separate cables using unidirectional repeaters.

Most submarine cable interruptions are man-made, either by trawling gear, ships' anchors, or are caused by a cable repair ship cutting into a cable in error. Consequently, going north of the area containing the existing submarine telegraph cables was the best way to avoid erroneous interruption by cable repair ships. Trawling is rarely carried out at depths greater than 250 fathoms, and therefore the danger from this interference usually concerns the approach to the shore, and the cable reached its point of landing in the deepest water available. Trawling is a real menace to submarine cables, and the cable ship Monarch, whilst laying the Transatlantic telephone cable off the Newfoundland coast, passed through a fleet of trawlers at work, and excitement prevailed on board when one trawler came unpleasantly near the cable being paid over the stern.

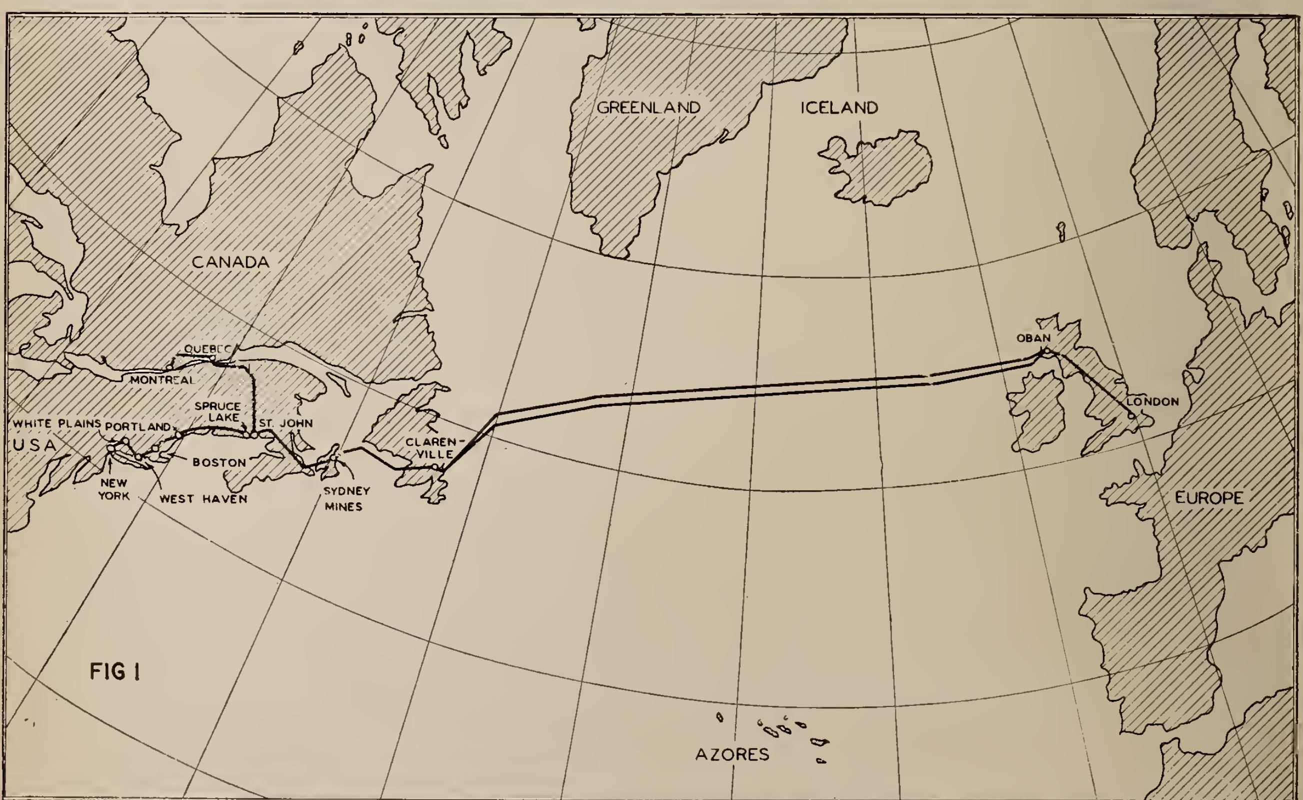
The type of cable employed for the Atlantic telephone is a polyethylene insulated coaxial cable, having a 0.620 inch diameter and a characteristic impedance of 50 ohms. The construction of the cable is shown in Fig. 2. The shore ends are heavily armoured with low carbon steel wire, whereas the deep sea type cable is armoured with much lighter gauge high tensile steel wire, this being done to improve the weight strength ratio of the cable, which is so important in respect of laying in very deep water. The attenuation characteristics of the cable are shown in the curve Fig. 3.

In order to avoid even small deviations from the design transmission objective, exceptional care was taken in the manufacture of the cable, automatic control being employed to retain the diameter to within 0.002 inch; at the same time the control of capacity and concentricity of the cable were maintained within very close limits.

Cable Power Supply

The maximum voltage that can be employed on the cable is at present limited by the voltage to ground, that can be impressed on the components of the repeater. Naturally, the voltage stress is a maximum on the repeater closest to the shore, for normally, power is fed at both ends of the cable, and therefore the repeaters near the centre are not very far removed from ground potential. It was determined from elaborate tests

Fig. 1. Route of the first transatlantic submarine telephone cable system.



that to ensure a minimum life of 20 years for the repeaters, the maximum working voltage impressed on its components, to ground, by the cable power supply, should not exceed 2,500 volts.

The Initial Number of Repeaters

The maximum number of repeaters to be employed in a cable initially, is determined by the voltage drop necessary to activate a repeater, together with the voltage dropped in to the surface of deep water. Consequently, the two ends of the cable when brought to the surface may be miles apart. Since to join these together necessitates the addition of a substantial length of cable, it is necessary to insert a repeater, for otherwise the attenuation of the repaired section of the cable would be substantially increased, which would lower the performance of the cable as a whole.

Therefore, it was imperative to been devoted to the design and manufacture of electronic components of low fault liability, within a given life period. With improvements of design, manufacture and materials, steady progress has led to the present fairly well developed state of the art. Even so, extraordinary precaution was taken in the production of all components used in the repeaters of the Atlantic cable. All the internal metal parts and component casing are gold plated to prevent crystalline whisker growth

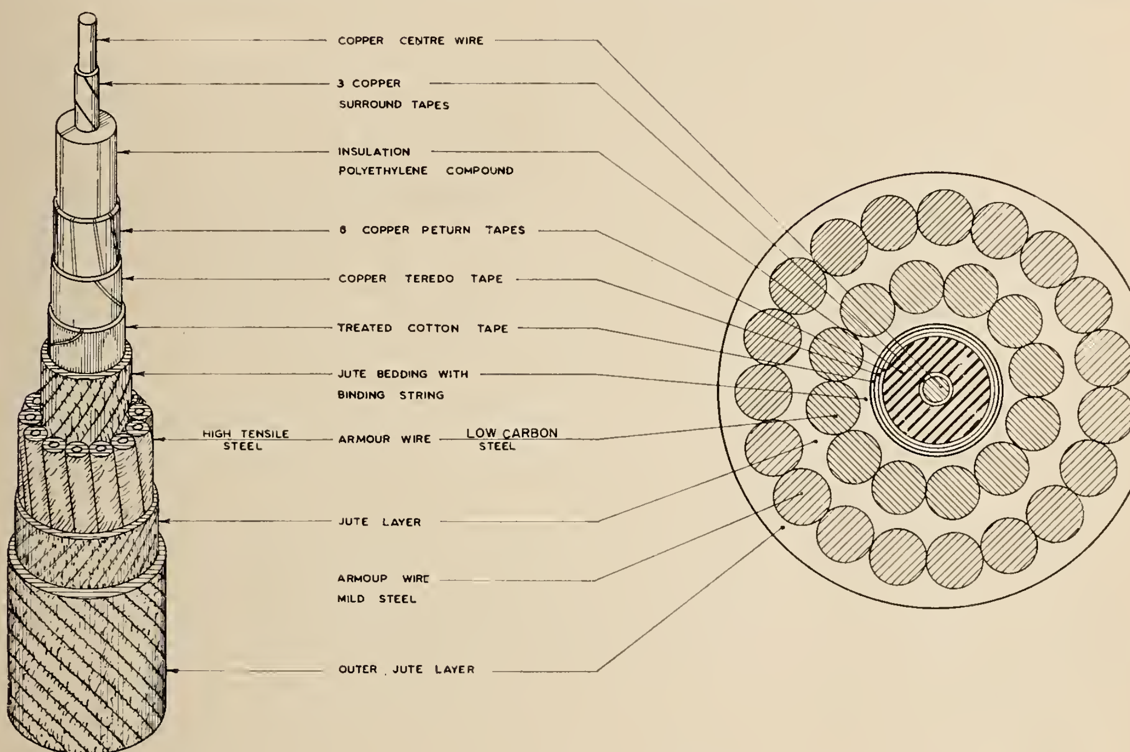


Fig. 2. Structural features of the deep-water type of cable.

the cable itself. The American flexible unidirectional repeater requires approximately 60 volts to energize it, whereas the British rigid type two-directional repeater requires 135 volts. The number of repeaters initially inserted in the cable must be less than the maximum permissible, especially is this so when a large part of the cable is laid in deep water. Fig. 4 shows the depth of the sea bed on the Atlantic telephone cable route.

The replacement of a repeater in deep water, or even the repair of a broken cable, necessitates the addition of a repeater, with a consequent increase in supply voltage to the cable. This will be readily understood when it is realized that, if not already broken, the cable has to be cut by the grapple before it can be lifted allow for at least four deep sea interruptions during the life of the cable.

Repeater Gain

Both the American and British type repeaters are designed to provide approximately 60 db gain at the high frequency end of the bandwidth concerned, and naturally the spacing of the repeaters had to be arranged so that this attenuation was not exceeded. Fig. 5 shows the gain of the two types of repeaters employed.

Component Fault Liability

Before contemplating laying 118 repeaters on the sea bed, the question as to repeater reliability received the utmost consideration. Naturally, the production of reliable repeaters was not a case of starting from scratch; years of untold effort have taking place.

The general principles of manufacture followed in respect of the Transatlantic telephone cable repeaters were as follows:—

(*a*) To use components of proven reliability, even though their use might not be in accordance with the latest technique.

(*b*) To use the best possible materials.

(*c*) Excessive precaution during manufacture of internal repeater parts and assemblies to exclude dust and direct contact with the human hand.

(*d*) Accelerated life testing where possible.

(*e*) Three months' testing of all finished repeaters before consignment for insertion in the cable.

As a result, the 118 repeaters employed were manufactured and laid successfully with one exception. Some minutes after the final splice was made on the Clarenville/Sydney Mines cable section, transmission became interrupted and the cable went dead. The fault was quickly located to the last repeater placed in the sea at the Sydney Mines end. This component had been joined to the cable and tested with Clarenville prior to making the final splice. Fortunately, the repeater was in shallow water and was quickly pulled aboard and replaced. Upon retrieving the faulty repeater, it was found to be in perfect working order, but on further inspection at the works, the trouble was located to a small capacitor inside of which was found a very minute ball of solder, which had moved during the laying of the repeater to cause the $50,000 piece of equipment to become useless. As a result, all capacitors to be inserted in the submerged repeaters are now inspected by X-ray before being used.

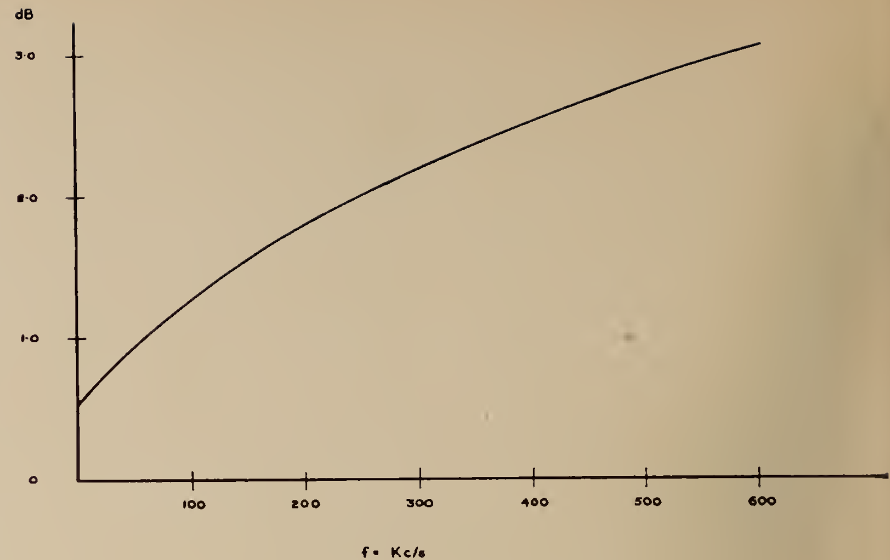


Fig. 3. Cable attenuation per nautical mile.

Cable Laying

The laying of a submarine telephone cable embraces all the difficulties encountered in laying a telegraph cable but in addition there exists the hazards associated with laying the repeaters. The American unidirectional repeater being flexible has the form of a larger diameter cable, and therefore is much easier to handle. This type of repeater can be laid without stopping the cable ship. However, it required the use of 6 to 7 feet diameter sheaves, which are larger than had been used previously, and the cable ship Monarch had to be modified accordingly.

The British type repeaters are rigid and, with existing cable ship facilities, getting them overboard in such a manner that no damage occurs to them, or the cable, is quite a task and necessitates the ship being stopped; consequently, they can, at present, only be laid in comparatively shallow waters. These rigid repeaters are fitted with supervisory devices so that the plane of the repeater during its passage to the sea bed can be observed. Also, any rotational movement on its main axis is similarly observed. The records obtained are very interesting, and show that the movement of the repeater is most disturbed, and that it rotates sometimes at considerable speed during its underwater journey to the sea bed.

Locating Faulty Repeaters

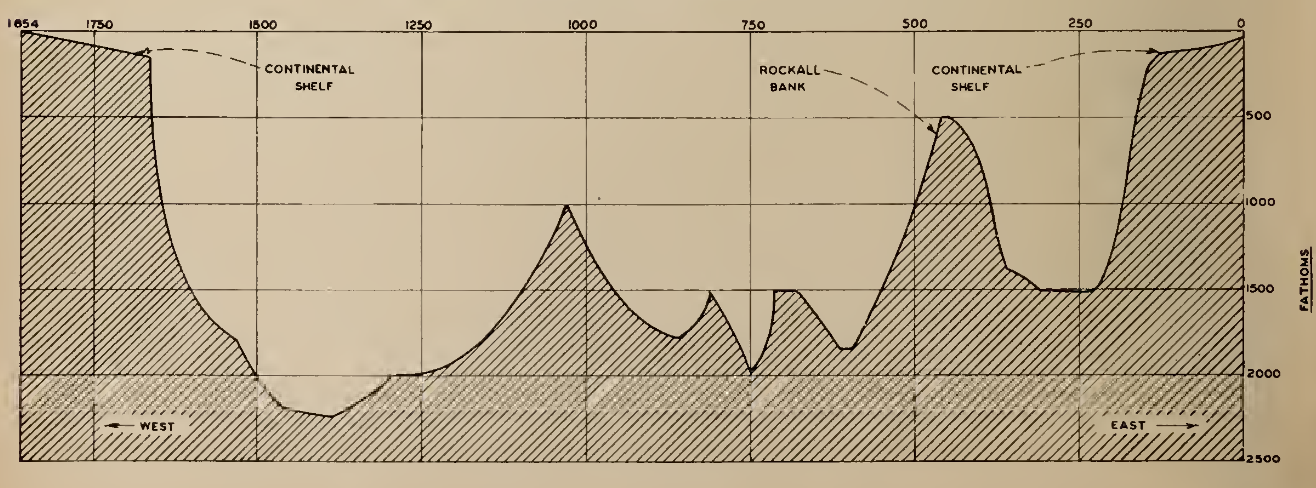
The means provided for testing is different for the unidirectional and two-way repeaters. The unidirectional repeater is arranged so that noise, outside the circuit band, passes through a crystal controlled filter, the output of which is then fed through the amplifier to the cable. The frequencies of these crystal-controlled filters are at 100 c./s. spacing for the various repeaters. By observing this narrow band at the terminal, the general condition of the repeater can be determined fairly well.

One of the tests applied to the rigid two-way repeater is to send from the terminal a test frequency which is selected and frequency doubled by a particular repeater and sent back to the testing terminal. Observing the returned transmission permits a reasonable assessment of the working of the repeater to be made.

Economic Considerations

Before the project was approved, it was concluded that the cost of providing the Transatlantic telephone cable was a sound investment in relation to its estimated earning power. The cost of the Atlantic telephone cable system, although not yet known

Fig. 4. Profile of ocean depths between Clarenville and Oban.



with absolute accuracy, is likely to be in the neighbourhood of $42,000,000. Consequently, it is a fair assumption that the cost of one Transatlantic telephone circuit, including its extension to the terminals of the Trans-Atlantic cable system, will involve a minimum capital investment of $1,250,000.

The interest on this investment, together with the maintenance charges, and profit, is estimated to be something of the order of $300,000 per annum, to which has to be added the out payment in respect of inland connections charges likely to approximate $70,000 per annum. This means that approximately 16,000 six-minute calls at $4.00 per minute would have to be carried annually on each circuit. From this it will be seen that it would have been uneconomical to have provided the cable, involving the cost of $42,000,000 giving less than 36 telephone circuits, if restricted to telephone service. However, owing to other earnings of the system, a considerably lighter traffic load can obtain with the profit objective being achieved.

A certain degree of economic relief was provided on the section between Clarenville and Sydney Mines, for by the addition of only two repeaters, the bandwidth was increased to provide 60 telephone circuits, and so 24 telephone circuits were made available on this section for domestic use; therefore this section is economically superior to the actual Atlantic section. The Transatlantic telephone cable system extends from Sydney Mines to Spruce Lake, N.B., in the form of a microwave section operating in the 4000 Mc/s. band. It is at Spruce Lake that the Canadian and American Transatlantic circuits separate into different routes, one going to Montreal and the other to New York.

Co-Ordinated Effort of Provision

The laying of the Transatlantic telephone cable represents a noteworthy engineering accomplishment, for to achieve its success, meant very close co-ordination between administrations having considerably different technical philosophy. Nevertheless, by frequent joint technical discussions, procedure was defined and provision scheduled. The result was a credit to all participants, for the work was kept ahead of the programme, and the cable was brought into service nearly three months before the date scheduled.

Performance Objective of the Montreal/London Telephone Circuits

The transmission objectives of the system were required to conform to the CCIF recommendations. The net loss objective between Montreal and London four wire test point was set at 0.5 db. The two wire termination loss at London is 3.5 db. which includes a 3 db. pad. The Montreal termination loss is 2 db. which includes a 2 db. pad, so that the overall net loss is 6 db. between the two wire switching points of Montreal and London overseas switchboards. The somewhat stringent overall tolerance on these objectives was set for the system at 0.75 db. deviation. Bearing in mind the number of different sections with their different systems of operation made this deviation objective an exacting requirement which, to all practical purpose, is being maintained.

Frequency Characteristics

The CCIF recommendation for frequency response for telephone channels is shown in Fig. 6, upon which has been plotted the performance of the Montreal/London channels, all of which fall inside the shaded area. Although the CCIF recommendations were accepted as a reasonable standard for the Transatlantic telephone cable system, it was considered to be below the objective desired.

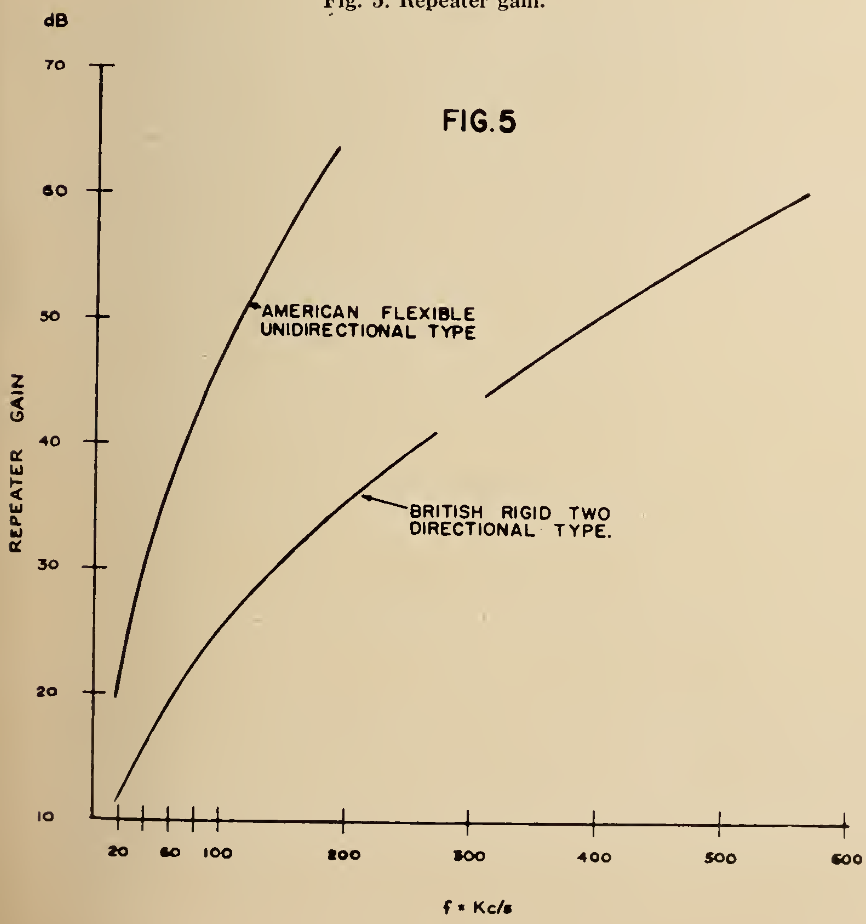
Programme Circuits

The cable terminal includes special equipment to establish "music" quality circuits, providing a bandwidth of either 6.4 or 10.4 kc/s., which utilizes two or three 4 kc/s. channels respectively. The excellent frequency performance of 6.4 kc/s. programme circuit is shown in Fig. 7.

Group Reference Pilots

The 36 telephone circuits of the cable are arranged in three standard groups of 12 circuits and each group contains a group reference pilot, located between the sixth and seventh channel, having a frequency of 84.08 kc/s. This pilot is injected at the two terminals of the system at 21 db. below the zero level reference point, and its received level is recorded at intermediate control stations as well as at the terminals. With this pilot, Montreal and London terminals produce a continuous record of the performance of the Canada/United

Fig. 5. Repeater gain.



Kingdom split group of the Transatlantic telephone cable system. The use of a systems group reference pilot has been introduced comparatively recently, and it has proved to be of great value in respect of maintenance.

Cable Bandwidth Assignment

It may be of interest to know the use of the transmission frequency bandwidth of the cable; this is given in Table No. I. When formulating this assignment, considerable caution was taken and it is not surprising that there appears further usable space available within the guard band of the two-directional section, and possibly at both the low and high end outside the band at present used. Tests are now in progress to determine what additional circuit capacity can be made available.

Canada/United Kingdom Circuits

As mentioned earlier, the Transatlantic telephone cable provides a two-way frequency bandwidth of 26 kc/s. for Canada/U.K. circuits. Six and one half 4 kc/s. voice circuits are obtained, and Fig. 8 is a systems schematic showing the appearance of these circuits throughout the system. Between Montreal and Sydney Mines, the 6½ circuits are contained within a group band which also includes the systems omnibus telephone order wire, and the systems telegraph order wire. The frequency characteristic of the 26 kc/s. band at various stations of the system is shown in Fig. 9, and these conditions are maintained in most cases to within a deviation of less than 0.5 db. The Transatlantic telephone cable system Canadian terminal is in Montreal and Fig. 10 is a photograph of the Montreal overseas test position; Fig. 11 is the telegraph test position which together form the Montreal system control centre.

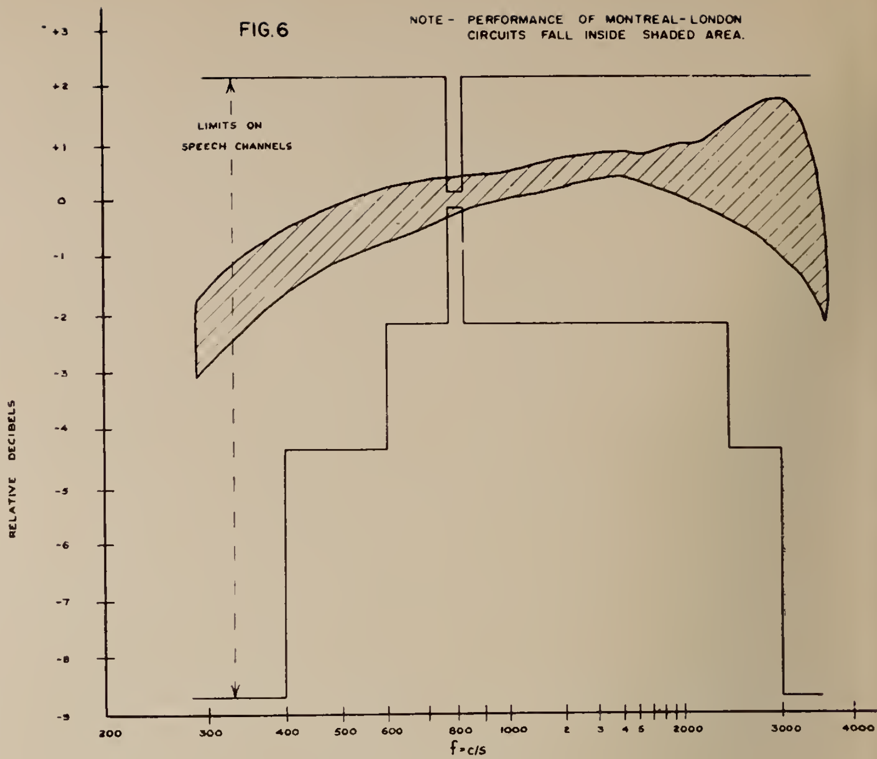


Fig. 6. CCIF voice channel frequency objective.

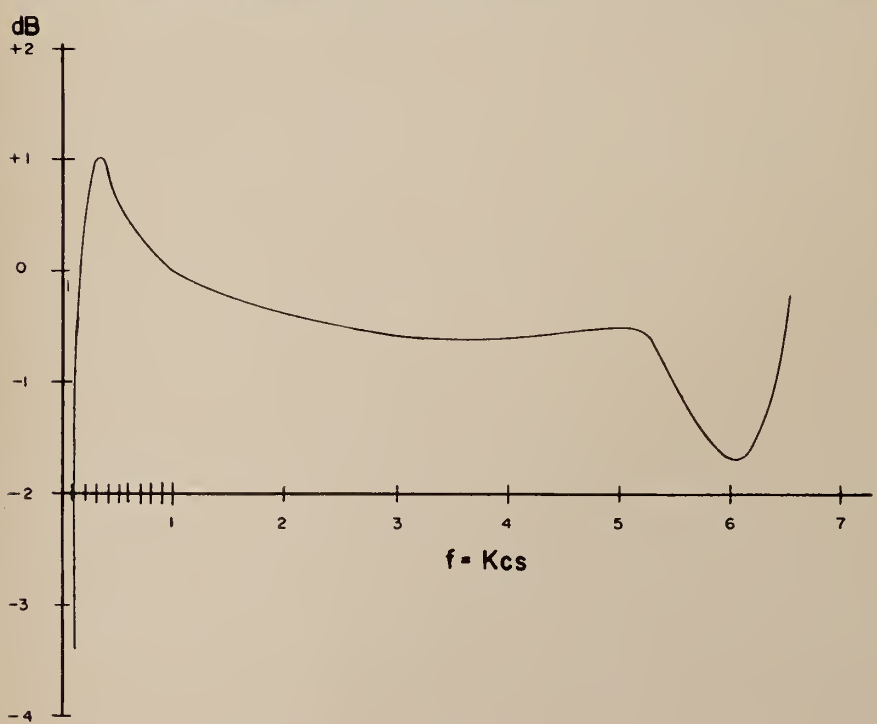


Fig. 7. Frequency characteristic 6.4 kc./s. music-in-band circuit, London to Montreal.

Transatlantic Telephone Traffic

In 1955, the Canadian Transatlantic telephone facilities comprised one full time and one part time radio telephone circuit, whereas at present, six cable and up to four radio channels are made available for public service at all times; except that the radio channels are not used unless they are "merit" 4, i.e., of very good commercial quality. Various estimates were made as to when the six Canadian Transatlantic cable telephone circuits would be fully loaded. Actually, the six circuits have been, more or less, fully taken up since the cable was brought into service on September 25th, 1956. Fig. 12 shows the growth of Transatlantic telephone traffic during recent years, and gives a fair indication of the manner in which the future demand will increase. The forecast for 1957 is very conservative and is likely to be exceeded considerably.

Additional Telephone Circuit Provision

The overload traffic condition, that so frequently obtains on the Transatlantic telephone circuits, indicates the immediate need for increased circuit capacitv, and raises the question as to the relative importance of quality of service in relation to availability of service. Naturally, by the use of conventional 4 kc/s. channel splitting equipment, the six Atlantic circuits, which provide a normal speech band 300/3,400 c.p.s., could be converted into 12, each having approximately 300/1800 c.p.s. speech band. This reduction in speech bandwidth is very undesirable, especially in regard to the extension of such circuits over a lengthy domestic network, but it has been suggested that this is preferable to prolonged delay in obtaining call connection.

Research has shown that by the use of improved filter design, the channel guard band can be reduced to 100 c.p.s. Thus, by an additional stage of modulation two circuits can be derived from a 4 kc. spaced channel, each having a 1.9 kc. usable bandwidth, to provide a speech

TABLE I.—Transatlantic Telephone Cable System Frequency Allocation

Atlantic Section: Clarenville/Oban and Oban/Clarenville Unidirectional Cables

15.235 kc/s.	London/New York teleprinter order wire (FM 35 c/s deviation)
15.405 kc/s.	Systems teleprinter order wire (FM 35 c/s deviation)
16- 18 kc/s.	Sydney Mines/Clarenville/Oban telephone order wire
18- 20 kc/s.	Omnibus telephone order wire
20-164 kc/s.	36 4 kc/s telephone channels
167-174 kc/s.	Repeater test frequency band (repeater test frequencies at 100 c/s spacing)

Newfoundland—Nova Scotia: Clarenville/Sydney Mines Two-directional Cable

West/East	East/West	
19.235 kc/s	525 595 kc/s	—Systems teleprinter order wire
19.405 kc/s	552 765 kc/s	—London/New York teleprinter order wire
20-260 kc/s	312-552 kc/s	—60 4 kc telephone channels
260-264 kc/s	—	—Repeater test frequency band (repeater test frequencies 120 c/s spacing)
—	520-528 kc/s	—2 4 kc inband channels released for repeater test
264-266 kc/s	308-310 kc/s	—Systems telephone order wire
266-268 kc/s	310-312 kc/s	—Sydney Mines/Clarenville/Oban telephone order wire

Group Band Pilot.

64 kc/s	— Frequency indicating pilot
84.08 kc/s	— Overall system group reference pilot
92 kc/s	— Section pilot

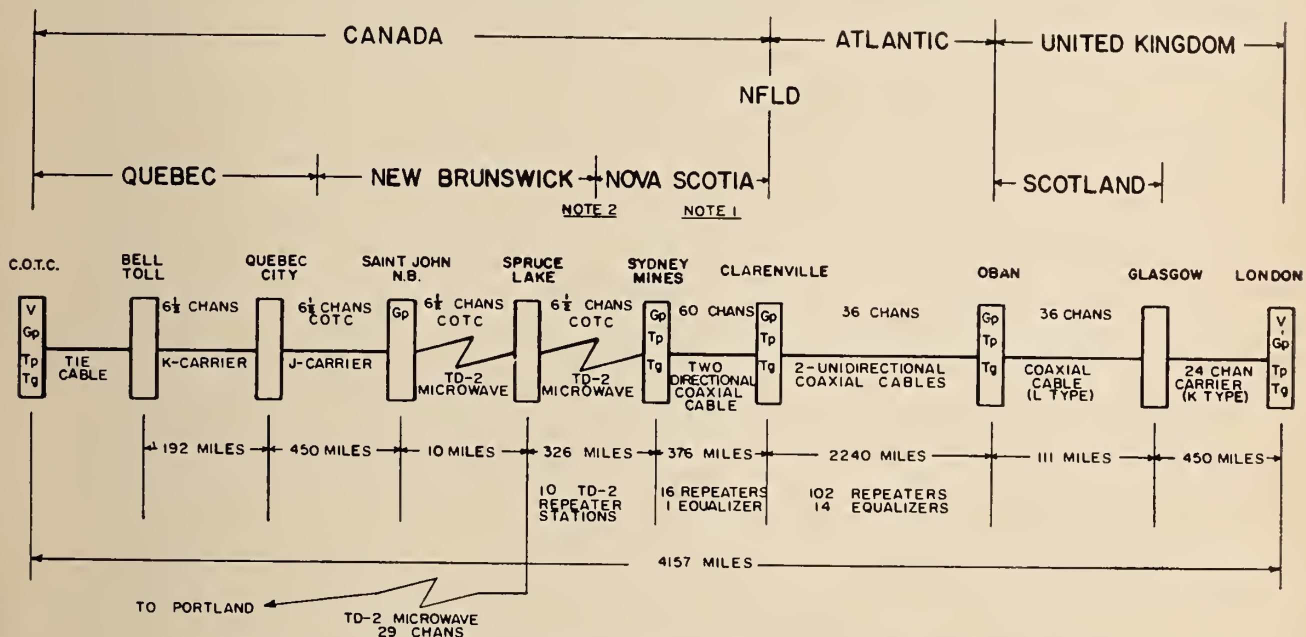


Fig. 8. System schematic of Canada/United Kingdom transatlantic telephone cable circuits.

bandwidth of 300/2200 c.p.s., which would be a fair quality voice circuit, and it is reasonable to suppose that the improved service would justify splitting the channels in this manner. It was concluded during recent technical discussions that 3 kc. channels separated by latest type filters will provide 300/3200 c.p.s. voice channels, and this appears to offer the correct solution to the problem of providing additional circuit capacity; consequently, the 4 kc. channels of the first Transatlantic cable may ultimately be replaced by 3 kc. channels. To do so, the appearance of the pilots in the cable groups would have to be modified. It would require considerable time to develop all the new filters, so that the use of the channel splitting equipment, first referred to, appears the short term solution.

Automatic Trunk Time Sharing

Whilst on this problem of maximum utilization of expensive bandwidth, it is of interest to note that over a four wire section of a telephone circuit, only one direction is in use at any one time, that is presuming one party is listening. In addition to this, the circuit over which the actual speech is passing has a substantial factor of idle time. The existence of this idle circuit time has led to the development of various methods of automatic sharing of trunk circuit time. Such methods, to justify their use, necessitate the availability of a minimum number of trunks. To describe the system very briefly: for example, 36 four wire circuits across the Atlantic could be arranged to enable, say, 72 or even more telephone conversations to take place over the 36 Atlantic circuits apparently at the same time. The system operates so that when a predetermined traffic load condition exists, the trunk sharing automatically comes into service. At the commencement of speech, following a predetermined pause, an idle trunk is seized via which the speech passes to the distant end, preceded by an indicator. This indicator directs the speech to the correct circuit extension, and in this manner, during a normal call, a person might have spoken over the entire 36 trunk circuits. To avoid clipping of the speech, delay lines of a few milli-seconds will be required at each end in both directions. It is arranged so that the trunk sharing does not operate until the connected circuits approach the number of trunks available.

This equipment is likely to be very costly, and may involve considerable fault preventive maintenance, but neither of these two factors should prove very objectionable, because the additional circuit capacity provided by this means over such costly media, as the Transatlantic telephone cable system, is of great traffic value and, consequently, there is every possibility that automatic distribution of trunk circuit time will become a normal method of expanding the use of such expensive trunk line facilities.

Telegraph Channels

The Canadian circuits of the Transatlantic telephone cable system, that is the six and a half voice circuits, provided on the 26 kc/s. bandwidth, are obtained by splitting cable group number one in the middle of the sixth channel, so that the Canadian bandwidth is 60/86 kc/s. and the remaining 86/108 kc/s. is for American circuits. The six Canadian telephone circuits utilized 60/84 kc. and the 84/86 kc/s. band accommodates eleven frequency modulated voice frequency telegraph channels plus one pilot.

The FMVFCT equipment provides 120 c.p.s. spaced channels, having a modulation deviation of 30 c.p.s. Test on these telegraph channels between Montreal and London show the distortion, at 50 baud keying, to be less than 4 per cent, and at 80 baud keying, distortion is about 10 per cent. As there is a great demand for telegraph channels in excess of those available, arrangements are being made to fit synchronous time division equipment to each channel, so that by suppressing the start and stop pulses over the cable, two 50 baud teleprinter circuits can be provided on each of the eleven telegraph circuits. The conservation of bandwidth in this manner on transoceanic circuits is a well worth while objective, especially in view of the rebirth of telegraphy, which is now taking place.

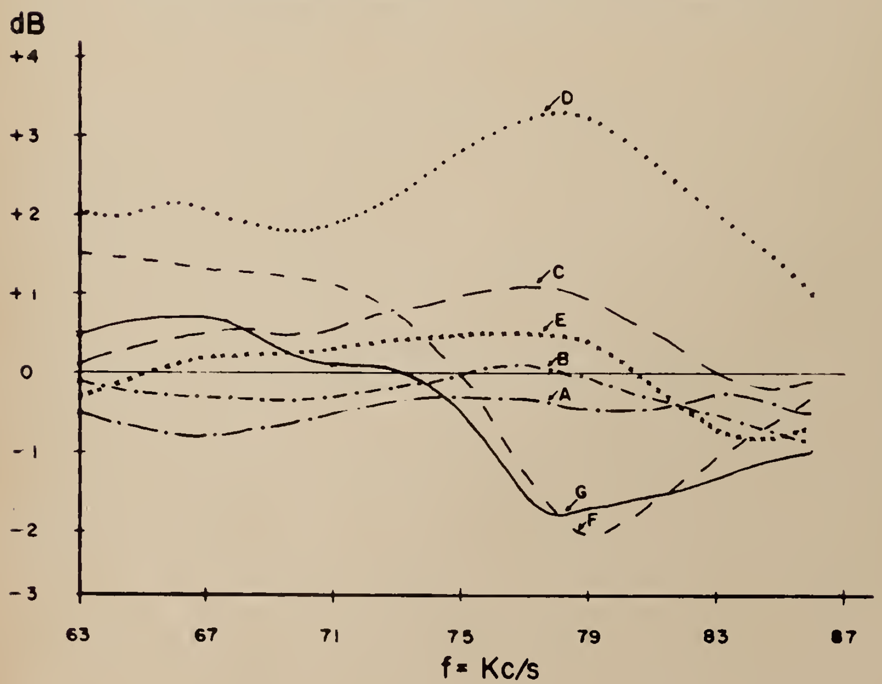
Also the use of narrow band frequency diplexing is being investigated, the object of which is to provide two circuits on a 120 c.p.s. spaced channel system. The diplex keying uses a four position frequency shift code, and a total deviation, from the mean channel carrier, of less than ± 30 c.p.s.

Consequently, it is reasonable to predict that, by combining time division multiplexing with the diplex, four teleprinter circuits can be provided on each of the eleven 120 c.p.s. spaced channels without increasing the transmission power, so increasing the Transatlantic telegraph channels to 44.

The ability to provide 96 standard speed teleprinter circuits on one 4 kc/s. speech channel in this manner is of considerable importance, and should engage the attention of telecommunication engineers.

Fig. 9. Split group system frequency characteristics.

CURVE	STATION	RELATIVE TO ZERO LEVEL POINT
A	LONDON	-37
B	OBAN	-8
C	CLARENVILLE	-8
D	SYDNEY MINES	-42
E	SAINT JOHN N.B.	-5
F	MONTREAL BELL TOLL	-5
G	MONTREAL C.O.T.C.	-8



Telex

Telex is the international term for a public switching system which provides teleprinter subscriber-to-subscriber connection. Such overseas service was provided in Canada by the establishment of a Telex switchboard in Montreal, which enables any of the Canadian Telex subscribers to obtain immediate connection with Telex subscribers of other countries. This Telex service has been discovered by industry, commerce, allied services, and Government departments as an extremely important and useful medium of communication, the phenomenal growth of which is shown on Fig. 13.

Since the service can be given without attention at the distant station, lack of co-ordination of business hours, which so often restricts the use of the telephone between countries, is not a real hindrance in the case of Telex. Further, the message to be sent can be prepared and checked before the call is made and so permits full utilization of the charged "call" time. The growth in the use of international Telex has, during recent years, been amazing, and there is no doubt that this service will develop very rapidly in Canada. Fig. 14 shows the Montreal Overseas Telex switchboard.

It would appear that telegraphy in this new form, will prove a great competitor to the telephone, in respect of overseas service, not only for the reasons given previously, but because Telex, or rather telegraphy, is the most accurate means of telecommunication; it is also the most economical of bandwidth. Telegraphy permits a substantial degree of signal prediction and error detection at the distant end. For example, by using a seven unit telegraph code, arranged so that the elements of each combination comprise three of one condition of modulation and four of the other condition, most errors, due to the transmission path, can readily be detected. Consequently, if a code combination is received without this ratio being recorded, the receiving equipment automatically detects an error and arrests printing, and then signals the sending end to effect automatic retransmission of the failed signal, and all thereafter. In this manner, in spite of mutilation to the transmission, a clean, accurate, printed message results. This automatic detection of received failures in transmission gives a means of supervising the entire transmission path, which is a very important facility and which may prove very necessary when lengthy telex circuits are set up, including microwave system, long carrier links etc., upon which hits or short interruptions obtained, such as would result in failures on unprotected teleprinter operation. Automatic repetition equipment has recently been brought into service on the Canada/Australia radio circuits with very successful results.

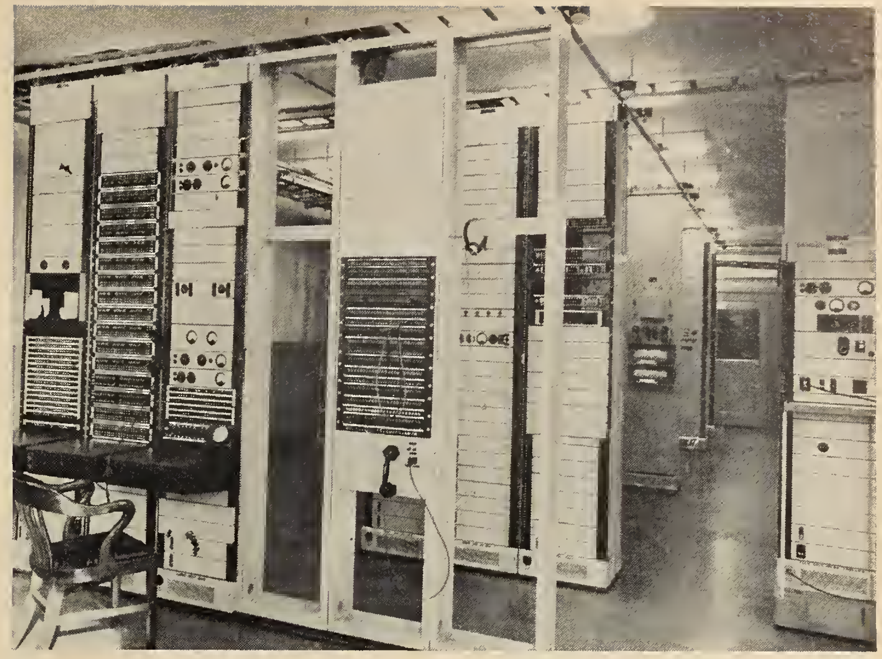
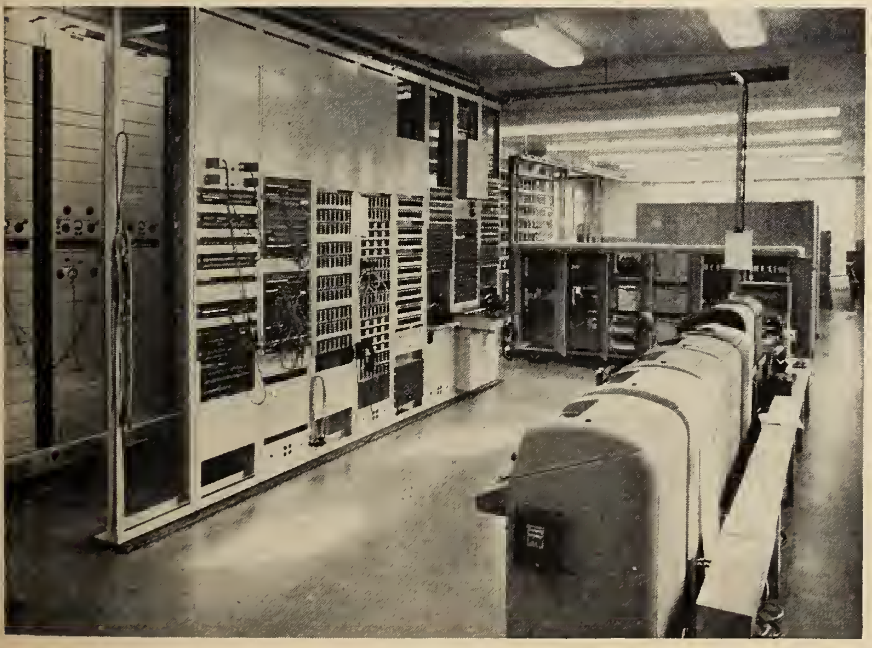


Fig. 10. Montreal overseas telephone test position.

Canada/Australia Telecommunication Development

Until the opening of the new radio stations in the Vancouver area in November last year, the public telecommunication facilities, between Canada and Australia, were limited to the two pacific telegraph cables and one radio telegraph circuit, the latter operating directly with the Montreal area radio stations. No public telephone service operated direct to Australia. The provision of the radio stations on the west coast was with the main object of providing direct radio telephone service, and telegraph circuits for covering interruption of the Pacific submarine telegraph cables, and at the same, to accommodate future expansion of telegraph facilities to Australia, New Zealand, and countries in the Far East. The reason why this was not done by expansion of the Montreal area radio facilities was due to the superior ionospheric path conditions existing between Australasia and Canada from the west coast.

Fig. 11. Montreal overseas telegraph test position.



New Vancouver Area Facilities

These new overseas telecommunication facilities on the west coast comprise a central telegraph office in Vancouver city, which connects with the Montreal terminal by Trans-Canada telegraph channels, and also with the cable station at Bamfield, located on the west coast of Vancouver Island. This is where the Pacific telegraph cables leave Canada for Australia and New Zealand. The Vancouver telegraph office also connects with the radio receiving station at Ladner, about 20 miles to the south. The Ladner receiving station remotely controls the radio transmitting station at Cloverdale, Fig. 15, which is about 20 miles distant.

Figure 16 is a block schematic diagram showing the Ladner and Cloverdale arrangement which, the author understands, embraces the largest radio transmitting station to be operated entirely unattended. The advantages of single sideband operation for telephony are well known, but an additional merit of such method of operation on busy routes is found in the application of independent sideband working which provides up to four telephone channels on one transmitter—two on each of the upper and lower sidebands. A sideband of 6.00 kc/s. wide is used which, by means of equipment, displaces one voice channel, so that two 3 kc/s. telephone circuits are established on one sideband, each providing a nominal 200/2950 c.p.s. voice channel. Thus the overall band width for the four channels is 12 kc/s. This method of operation has the advantage that interference can obtain in part of the band without necessarily preventing the operation of circuits in the other part. It is this flexibility which makes ISB such an excellent method of operating in crowded parts of the radio spectrum.

Cloverdale Radio Transmitting Station

As a consequence, the Cloverdale transmitting station was equipped with three ISB transmitters, each giving a peak power of 30 kw. on telephony. A 5 kw. DSB transmitter was also provided for service development purposes. The transmitting station, as mentioned previously, is controlled from Ladner, and a 6000 megacycle microwave system connects the two stations and provides 18 telephone channels, one of which is being used to provide multichannel voice frequency circuits necessary to establish remote control. Although recordings of the field strength indicate very frequent sharp fading on the micro radio path, the out-of-service time is extremely small. Fig. 17 is a photograph of the Cloverdale transmitter hall.

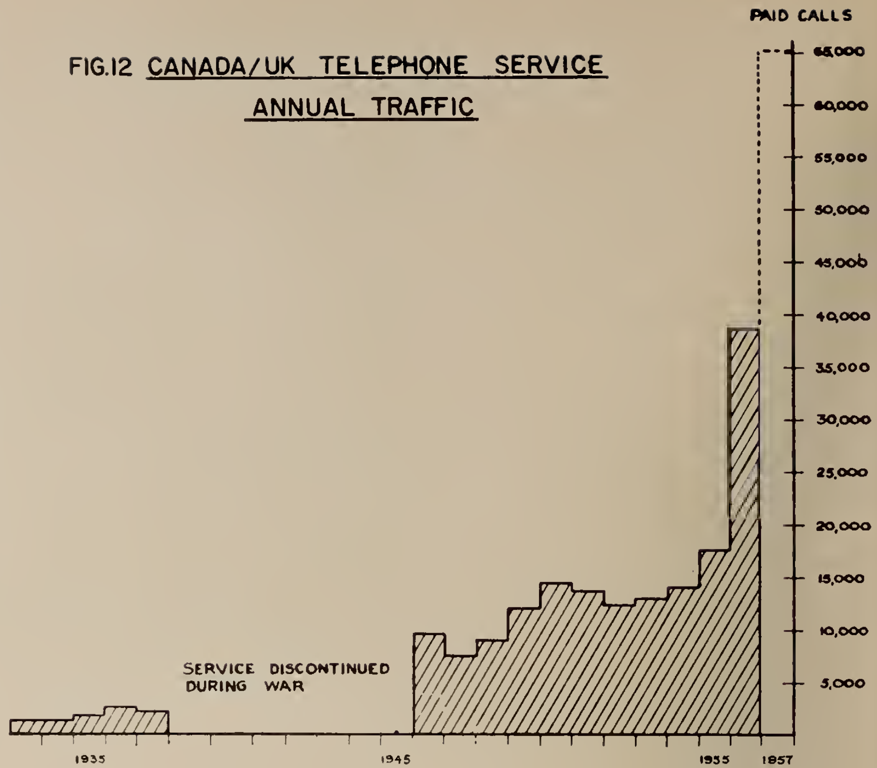


Fig. 12 (above). Canada/U.K. telephone service, annual traffic.

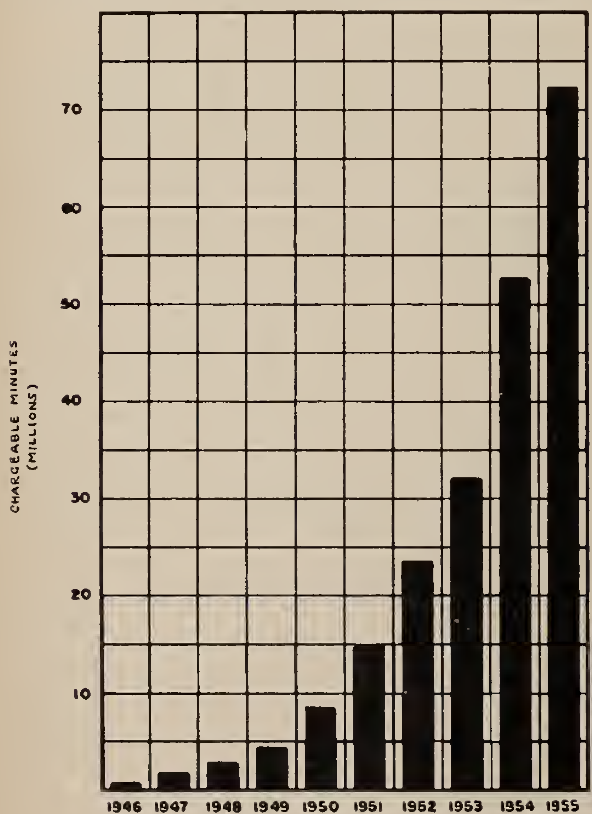


Fig. 13. International Telex traffic: chargeable minutes (extracted from I.T.U. Journal).

The ISB transmitters were specifically designed for remote operation, being equipped with some 15 motorized tuning units. Fig. 18 is a photograph of the transmitter with the air tight doors removed. Separate associated crystal drive units are employed each comprising 6 crystal drive outputs which, by insertion of a suitable crystal, enable the transmitter to be adjusted for operation on any desired frequency within the range 4 to 27 Mc./s.

Another piece of associated equipment is the Independent Sideband Drive, which embraces two balanced modulators providing for two modulating inputs of 100/6000 c.p.s. In this equipment the unwanted sidebands are suppressed, and the wanted upper sideband and a lower sideband are combined with a low level 3.1 mc/s. pilot carrier, which feeds into the frequency changing stage of the transmitter to drive a substantially linear amplifier.

Monitoring facilities are provided to enable intermodulation distortion, carrier level, and other measurements, to be made at all salient points of the equipment. Multichannel voice frequency telegraph channel equipment, having three 1000 c.p.s. spaced channels, each employing frequency shift keying with a ± 200 c.p.s. deviation, is employed on any of the voice circuits, the three voice mean frequency carriers employed being 600, 1600, and 2600 c.p.s. This arrangement permits narrow band receivers to be used for recording the channels separately. Each of these telegraph channels can be keyed up to 120 bauds.

Rhombic antennae are employed at the transmitting station because of their directive quality of propagation, their better efficiency over a relatively large frequency band, and because of their simplicity of construction. This choice meant different antennae for Australia and New Zealand, even though their bearing differs by only 20°. At the receiving station, horizontal array of dipole (HAD) antennae are used in spaced diversity, the HAD being employed because of its broader major lobe pattern which accommodates for variation in azimuthal arrival angle, which means that one antenna can cover the 20° difference in bearing angle of the Australian and New Zealand routes.

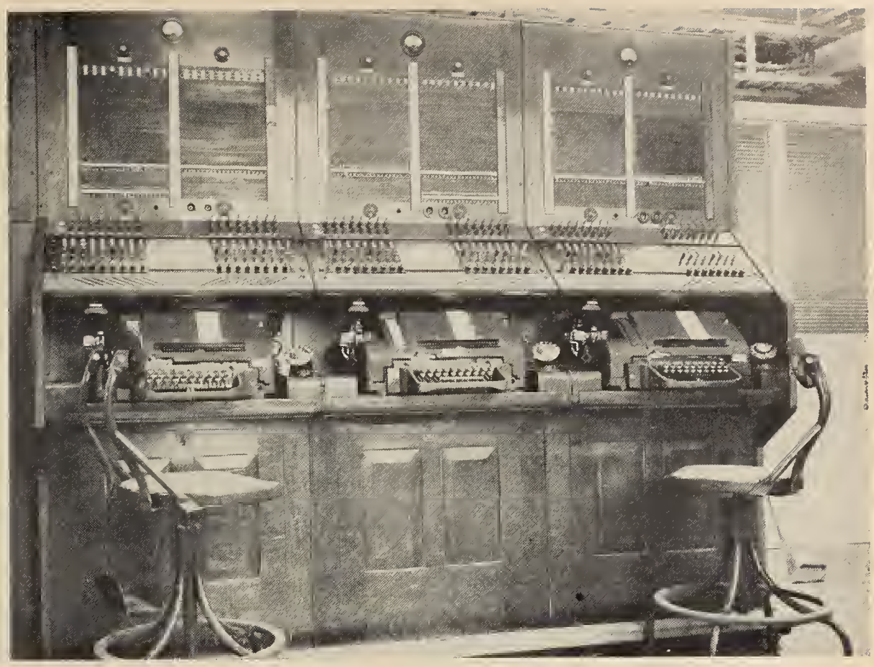


Fig. 14. Montreal overseas Telex switchboard.

Ladner Radio Receiving Station

This station is equipped with the latest ISB receivers, Fig. 19, which have automatically synchronized carrier generating equipment. They provide two outputs upper and lower sideband each of 100/6000 c.p.s., and when four channels are provided, each output passes to the channel restoring equipment, each of which provide two 200/2950 c.p.s. outputs. For connection with the public telephone system, the received circuits are fed via a constant volume amplifier (Vogad) to a telephone terminal which, in a conventional manner, provides for two or four wire connection. To provide for improved secrecy on the radio path the incoming speech on the line side of the terminal is divided into five separate sections of the speech band. These sections are permutated in a time sequence so that the resultant modulation of the transmitter is unintelligible. Naturally, the reverse translation has to take place at the distant end. This five band privacy equipment, such as it is called, has a cycle of 36 different combinations which are switched automatically at a predetermined interval of 4 to 20 seconds, and although not providing for absolute secrecy, offers substantially greater protection than the methods of inversion, previously employed. Means are provided for measuring the circuit delay time to permit correct synchronization between the two ends of the circuit.

Fig. 15. Cloverdale transmitting station.

Telegraph Receivers

The telegraph receivers provided for receiving the FSK transmission on a channel of the three multichannel system, previously referred to, are of a design employing triple superheterodynes with crystal filters on the second IF stage, providing bandwidths of 0.5, 1.0 and 2.0 kc/s. In this manner, a very narrow band receiver is provided having automatic frequency regulation operating under the control of either the mark or space frequency. They cover a range from 3.0 to 27.5 mc/s. in four bands having crystal control of six spot frequencies.

Remote Control

The system of remote control of the Cloverdale transmitting station employs FM telegraph circuits between the two stations. By dialling a predetermined sequence from a control panel at Ladner, any switching function desired to be performed at the transmitting station is selected; indication is displayed at Ladner, by automatic transmission from Cloverdale, as to the actual function selected. Should it not indicate the desired switching, it is cleared, and a second attempt made. Providing the indication is correct, an operate key is depressed at Ladner, following which the required switching is then automatically performed at Cloverdale. The transmitter monitors are fed back to Ladner so that the actual performance of the transmitter can be observed. To prevent fortuitous operation of the remote control, it is arranged to monitor the telegraph channels used for the operation of the remote control equipment, so that should the telegraph channel on encouraged a desire to improve telephone and telegraph facilities between Australia and the United Kingdom, which has, up to the present, been largely dependent on direct radio circuits—entirely so in the case of telephony.

Considerable effort has been made in the past to improve this very troublesome direct radio path by tralia passes through the Suez Canal area, which circuits may be taken from British control. Consequently, a route to Australia and New Zealand, via Canada, is becoming more important each day. It is desired to establish through telephone facilities between the United Kingdom and Australia via the Transatlantic telephone cable, Trans-Canada facilities

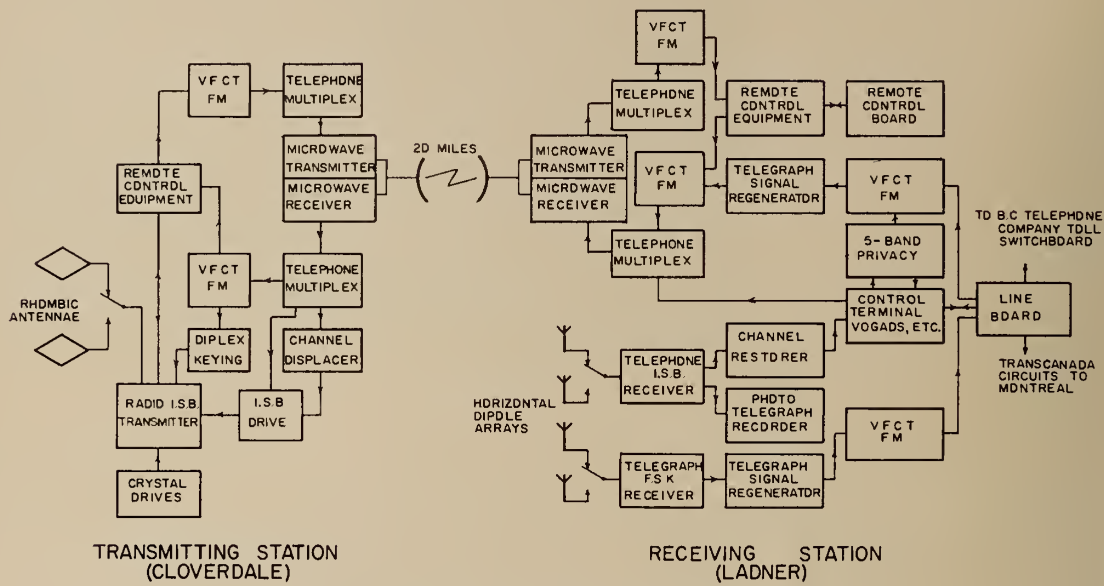


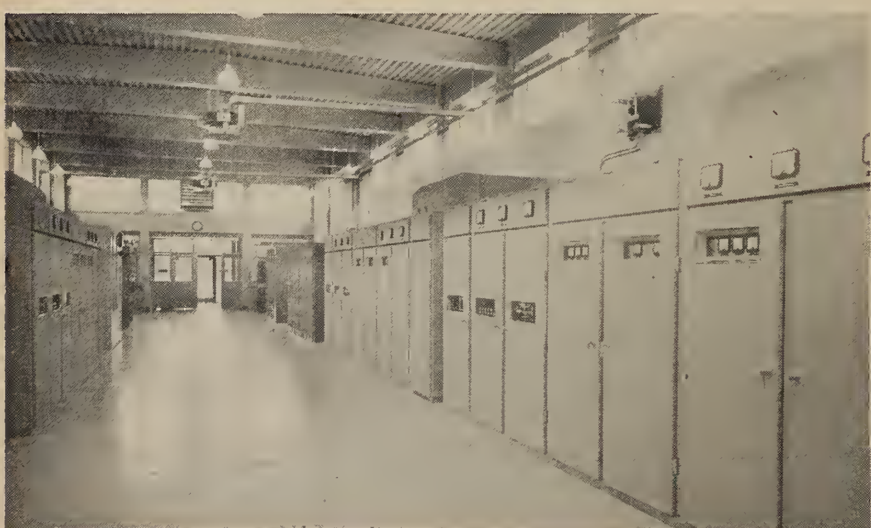
Fig. 16. Schematic of the Vancouver area radio stations.

the microwave be troubled with noise or interruption, an alarm is given and the remote control equipment is made inoperative.

Interconnection of Australasia With Europe Via Canada

These recent expansions of Canadian telecommunications both across the Pacific and the Atlantic, have establishing radio relay stations at Barbados, Ascension, and at Colombo, in Ceylon. Even so, radio communication between Australia and the United Kingdom is invariably interrupted for some hours each day, and at some times for days on end; therefore, a better route has considerable attraction. Also, the main route of the telegraph cable circuits to Australia and radio from Vancouver. Also, it is required to extend this service via London to other countries. This means that circuits of from 6 to 8 thousand miles in length would be connected with the Australia/Vancouver radio route, which adds more than another 6000 miles to the circuit, and therefore the "via net loss" and noise must be kept within limits if useful facilities are to be provided. Even with the use of companders and Vogad equipment, the present circuit performance does not come within the desired standard, but there is every reason to state that, before very long, good telephone service will obtain over these phenomenally long circuits, which will prove of great importance to the Commonwealth nations.

Fig. 17. Transmitter hall at Cloverdale.



Future Trends in Overseas Telecommunications

It would seem that the usefulness of radio for transoceanic communication has reached its peak—that owing to crowding in the HF spectrum, the value of the submarine cable, for bridging the oceans, is finding favour. The cable referred to is of coaxial construction employing, as may be necessary, submerged repeaters. In fact, we are on the threshhold of the development of a global wideband submarine cable network.

Naturally, no technical paper would be complete without some reference to transistors or television, and this will be no exception. As is well known, there is no fundamental technical difficulty in providing wideband trans-oceanic cables; the difficulties encountered are in the practical execution, for if the repeater spacing is made six to eight miles apart, a bandwidth suitable to accommodate television in one direction could be provided in a cable. However, this would mean over 300 repeaters in a trans-Atlantic cable section. Assuming the use of the existing design of submerged repeaters, the use of 300 repeaters would necessitate the cable being powered by more than 20,000 volts, and the application of this high voltage—even though it was applied half at either end—would, at the present time, be impracticable.

Consequently, the avenue of development of wideband long haul ocean telephone cables does appear to await the provision of a suitable, very low voltage tube or a transistor of proven integrity, and when this point is attained, the author suggests that laying unidirectional cables may be reverted to as general practice, and that in all probability, the repeaters may become very much a part of the manufacture of the cable. However, it is a reasonable assumption to conclude that the transistorized cable is some years away, and the immediate line of action is to devise all possible means to ensure the maximum use of the bandwidth that can be provided by a cable conforming to present technique.

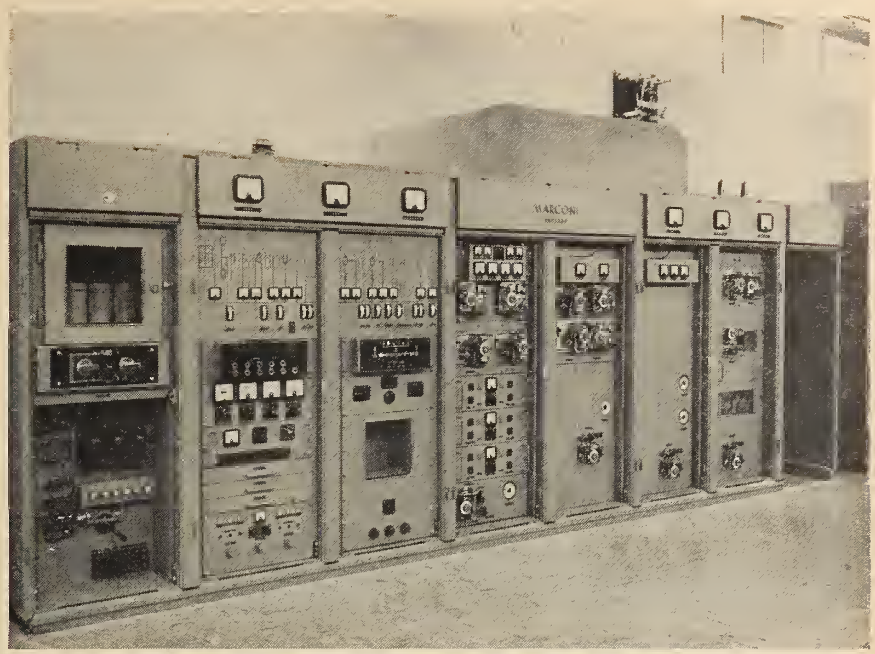


Fig. 18. One of Cloverdale SSB 30 kw. transmitters.

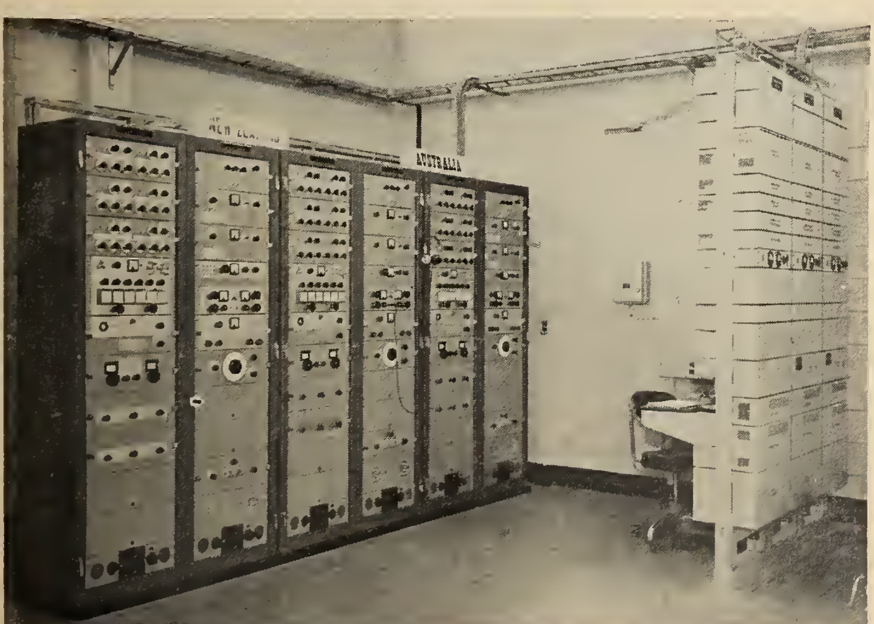
New Type Cable (Fig. 20)

Proceeding in this direction, the British have proposed to abandon outside armouring of the deep sea cable and employ a cable having a stranded high tensile steel central support wire located inside a tubular centre conductor. The central stranded support cable is constructed with reversed helix lay which eliminates practically all tendency for the cable to twist, which at present obtains under the tension of laying, and which naturally occurs in the reverse direction when the cable passes out of tension. Consequently, this twisting of the cable can be seriously troublesome, either during laying or when recovering cable from deep sea, being most active either at the point where the cable reaches the sea bed or on the ship's deck.

Another feature of this new type cable is found in the fact that the outside covering is polythene and is practically impervious to deterioration. This is an essential difference to the existing external armoured cables which, although having a heavy external serving of bitumized jute, after the passage of time the armouring corrodes, and the position is ultimately reached when the cable cannot support its own weight when being lifted from the sea bed for repair. When this stage is reached, there is no alternative but to abandon the cable. This condition should not obtain with the new type cable; in any event, its life should prove to be many times that of existing cables.

Another feature of the new cable is its weight strength ratio. The new cable, as will be seen from the table (Fig. 20), gives a greater margin of strength. This is a very important feature as it obviously will permit cable laying to be carried out in rougher weather than can be done with the conventional submarine cable. Naturally, these advantages, combined with the fact that the new design of

Fig. 19. ISB receivers at Ladner.



cable is relatively cheaper, and which also permits a cable to be provided having much less attenuation than could be obtained with a conventional cable at similar cost, makes its use most attractive. Also, it must not be overlooked that, since the new type cable is so much lighter, the handling on the cable ship during loading or laying is that much easier, which must help to reduce the cost of laying the cable. All in all, this new type cable would appear to indicate that its use will be favoured in future ocean cables for the deep sea sections.

There are one or two difficult problems associated with the use of this new type cable, one being the jointing of the central steel support cable, and another is the joining of this new type cable to externally armoured cable, which must be used in shallow water. Various methods of satisfying these and other requirements are now being investigated and the position looks promising.

Whilst we are forced to use thermionic tubes in the submerged repeaters, it would seem most likely that the rigid two-directional repeater may come into general use. This is primarily because of the high cost of cable and the need to employ many more repeaters when unidirectional cables are provided. This presents a problem, because cable laying ships at present are not designed to provide for the laying of cable with repeaters, except those that are flexible and can pass over the bow or stern sheaves. Laying the rigid type repeaters is done without great difficulty in shallow water, because the weight of the suspended cable in the sea from the ship can be handled with reasonable precautions being taken; even so, it necessitates stopping the cable ship. The whole crux of the problem is to get the repeater from the ship in such a manner that the strain due to the suspended cable is taken through the length of the repeater in a steady gradual manner, as it is fed from the ship into the sea. Methods have been conceived how this might be done, and it is proposed to carry out tests in the very near future. The real answer is to build new cable ships specially designed for the laying of rigid repeaters.

Conclusion

It is envisaged that the future holds very little prospect for the provision of many new HF international radio circuits, but one can predict that it will see the laying of a large number of trans-oceanic coaxial cables with submerged repeaters, which, during the early phase of the era, will most probably tend towards the single two-directional cables with rigid repeaters, using a light weight type cable for the deep sea section. Later, when the transistors replace the thermionic tube, this trend may change by a reversion to unidirectional cables.

In the telegraph telecommunications field, it is considered reasonable to suggest that telex will continue to grow and the public telegraph services may cease to operate as a sep-

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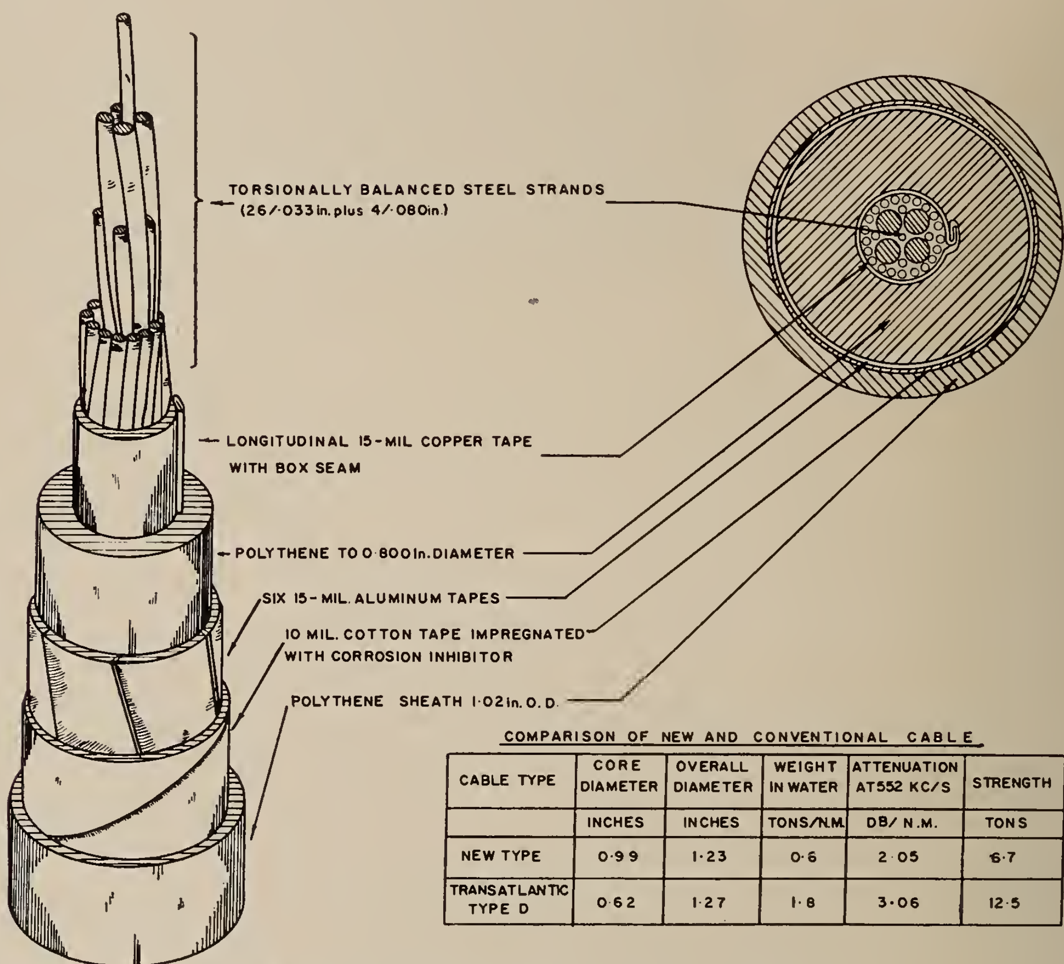


COMPARISON OF NEW AND CONVENTIONAL CABLE

CABLE TYPE	CORE DIAMETER	OVERALL DIAMETER	WEIGHT IN WATER	ATTENUATION AT 552 KC/S	STRENGTH
	INCHES	INCHES	TONS/N.M.	DB/ N.M.	TONS
NEW TYPE	0·99	1·23	0·6	2·05	6·7
TRANSATLANTIC TYPE D	0·62	1·27	1·8	3·06	12·5

Fig. 20. Structural features of new deep-water type cable.

Battle River Steam Station

J. N. Ford, M.E.I.C.
Manager of Operations, Canadian Utilities Limited, Edmonton, Alta.

W. I. McFarland, M.E.I.C.
Partner in Haddin, Davis & Brown Limited, Calgary, Alta.

Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June 1957.

In Alberta, as in other parts of our Dominion, kilowatt hour requirements have been increasing at a rapid rate. In this particular section of Alberta the kilowatt hour consumption has been increasing 15 per cent per year while peak load demands have been going up 12 per cent per year. When one considers that a 12 per cent annual increase in peak load means doubling peak load figures every 6½ years, and when it is necessary to place orders for generating equipment two to three years ahead of the commissioning date, it is most important for electric utilities to make a forecast of load requirements well into the future. The study of these forecast data made it clear that we would require additional generating facilities by 1956. Since facilities at existing plant sites limited the plant output, a new site was required to offer facilities capable of producing 120 Megawatts or better.

After considering numerous possibilities, it was decided to locate on the Battle River, south of the town of Forestburg. Coal was already being strip-mined by two coal companies near the selected site, one on each side of the river. The coal reserves were therefore known, and with more than one coal company operating in the area the benefit of competition could be reaped in so far as price is concerned.

Water could be supplied from the Battle River by constructing an earth-filled dam across the valley to create a reservoir. Contours indicated the man-made lake would be 10 miles long and ½ mile wide.

In addition to providing the essentials, fuel and water, for the proposed plant, the location was ideal geographically, being about midway between our two existing steam plants and at the load centre of the two areas to be supplied, the Vegreville and Drumheller districts. This planning made necessary the construction of a 138 kv. transmission line to connect the Battle River and Vermilion stations and also two 69 kv. lines to tie the Drumheller plant to the system.

Having established the reasons for constructing the plant at its present location, let us now consider the mechanical features of the Battle River station.

Forecasts of power requirements in Alberta indicated that, by 1956, new generating capacity would be needed on a site with a potential of 120 Mw. or more. The paper describes the background of the plant, its design, and equipment.

The Coal Supply

The American Society of Testing Materials classification of the coal is sub-bituminous Class C. It is found in the Edmonton formation. Cover varies, but a typical section in an existing mine shows thirty feet of clay and soft shale, six feet of coal, fifteen inches of soapstone clay, fifteen inches of bone, eighteen inches of coal and one repetition of the soapstone, bone and coal layers. The drainage conditions are good and the deposit is favourable for open pit mining operations. Operations of the mines are seasonal. The market covers a portion of Central Alberta where gas has not taken over, and extends into Saskatchewan and Manitoba. There is a market for much of the slack coal in Saskatchewan. Freight charges necessitate slack being sold for a low price at the tipple.

Typical analyses of the coal from this area are shown in Table I. These analyses are taken from the 1953 edition of Analysis Directory of Canadian Coals, published by the Department of Mines and Technical Surveys, Mines Branch, Fuels Division, Ottawa.

It will be noted from the analysis that the coal is high in moisture, but low in ash, sulphur and heating value. The coal slakes in storage. It can be stored in large outdoor stock piles if crushed and well compacted.

Coal from this area had never been used in pulverized fuel furnaces. Our company has, however, been pulverizing sub-bituminous Class B coal in Drumheller since 1947. In order to obtain some preliminary information on the performance of the coal from the plant area several carloads of slack coal were shipped to Drumheller for experimental firing. An average analysis from samples on these shipments was as shown in Table II.

This analysis was used in asking for tenders on the coal firing equipment.

Long term contracts were signed with the two large mines operating in the area for the supply of the plant requirements. These contracts provided a basis for calculating the price of coal, either slack or mine run. A base price was set with a formula for adjustment according to changes in equipment and labour costs. The price was based on delivery by truck to the receiving hopper at the plant.

Fig. 1. Battle River station, located on Battle River south of Forestburg, Alta.

The contracts also protected the Utility Company if the mines should cease operation. The Utility Company could take over operations under such circumstances.

In the early stages of the contract slack coal will make up a good proportion of the plant requirements. As the load grows a larger proportion of mine run will be required. However, the favorable price on mine run coal will make the fuel costs very moderate at all times.

Selection of Unit Size

The selection of the size of turbogenerator is always one of the first items to be settled in a power plant development. This selection is governed by the size of the system into which the unit is to be connected, and the expected growth of the system. The ability of the system to supply its load requirements with one unit out of service must be considered.

Referring to the line diagram of the system (Fig. 2) it will be seen that the Battle River station is located approximately midway between generating stations at Drumheller and Vermilion. The system is interconnected with the Calgary Power system at Drumheller, Holden, and Wainwright. These inter-connections will be strengthened over the next few years to minimize the seriousness of a shutdown in the Battle River station. Since fuel at Battle River was to be somewhat cheaper than at Drumheller and Vermilion it was desirable to install a unit which could carry a high proportion of the total load on the system. A unit of 30,000 kw. was decided on, as this size seemed adequate to meet these conditions for several years. It practically doubled the capacity of the system and could generate a large percentage of the energy requirements of the system until a second unit would be required for capacity. The actual machine purchased has a maximum capacity of 32,000 kw. if the power factor is kept up to 90 per cent.

Power shortage due to an outage of the 32,000 kw. unit during peak load periods can be supplemented from other sources; i.e., existing plants plus interconnections. The reliability of modern boilers and turbines coupled with planned maintenance has reduced the likelihood of outages, and it is believed that reliable service can be offered from this single unit plant. Although some early consideration was given to a 15,000 kw. initial installation, such a unit would have required bolstering with added capacity within a very short time, and the use of several small machines would have resulted in higher building costs and a complicated operating procedure.

Selection of Steam Generating Unit

Having decided on an installation approximating 30,000 kw., the next consideration was given to the size of steam generating unit and method of firing. It is obvious with coal at 8,300 B.t.u./lb. the quantity to be burned will be about 50 per cent greater than with 12,000 B.t.u. coal. This influences the type of firing.

Several methods of firing are available, such as travelling grate, stoker, spreader stoker, pulverized fuel, and cyclone firing. If a single unit were decided on, it would be out of the

Table I.—Coal Analyses

Size	Lump and Stove	Stoker Nut	Slack
Chemical Properties:			
Proximate analysis (as received)			
Moisture . . . %	24.5	25.2	24.0
Ash . . . %	7.1	7.2	7.9
Volatile matter . . . %	28.8	29.0	28.8
Fixed carbon . . . %	39.6	38.6	39.3
Calorific values (as received)			
B.t.u./lb. . . .	8,825	8,565	8,685
Ash softening temperature, °F . . .	2,110	2,210	2,085
Caking Properties:			
Volatile matter residue—950°C . . .		Non-agglomerate	
Caking index (Grey) . . .		0	
Swelling Properties:			
Swelling index (A.S.T.M.) . . .		0	
Swelling index (F.R.L.) . . .		Negative	
Ultimate Analysis (as received):			
Carbon . . . %	50.4		
Hydrogen . . . %	3.6		
Nitrogen . . . %	0.9		
Sulphur . . . %	0.4	0.4	0.3
Oxygen . . . %	13.1		
Analyses for Classification:			
Capacity moisture . . . %	26.5	26.5	26.5
B.t.u./lb. (capacity moisture basis)	8,590	8,415	8,400
Classification by Rank:			
A.S.T.M. . . .		Subbituminous C	
S.V.I. . . .		110–Lignitic	
Grindability index . . .	37.6	36.6	36.6

range of the travelling grate and spreader stoker, leaving only the cyclone furnace and pulverized fuel as possibilities. In fact, no design of a cyclone furnace had at that time been completed for such a small unit, so the choice really was between a single pulverized unit, and two units of pulverized fuel, spreader or travelling grate stoker.

The company had considerable experience with pulverized fuel at Drumheller and were satisfied with this type of firing. The travelling grate and spreader stoker have moving parts within the furnace and some relatively minor breakages may require two or three days shutdown in order to cool the furnace, complete the repair, and place the unit back in service.

There is a tendency to consider the steam generating unit as more subject to outages than the turbo-generator. The record of availability of modern pulverized steam generating units, however, compares favourably with that of the turbo-generator.

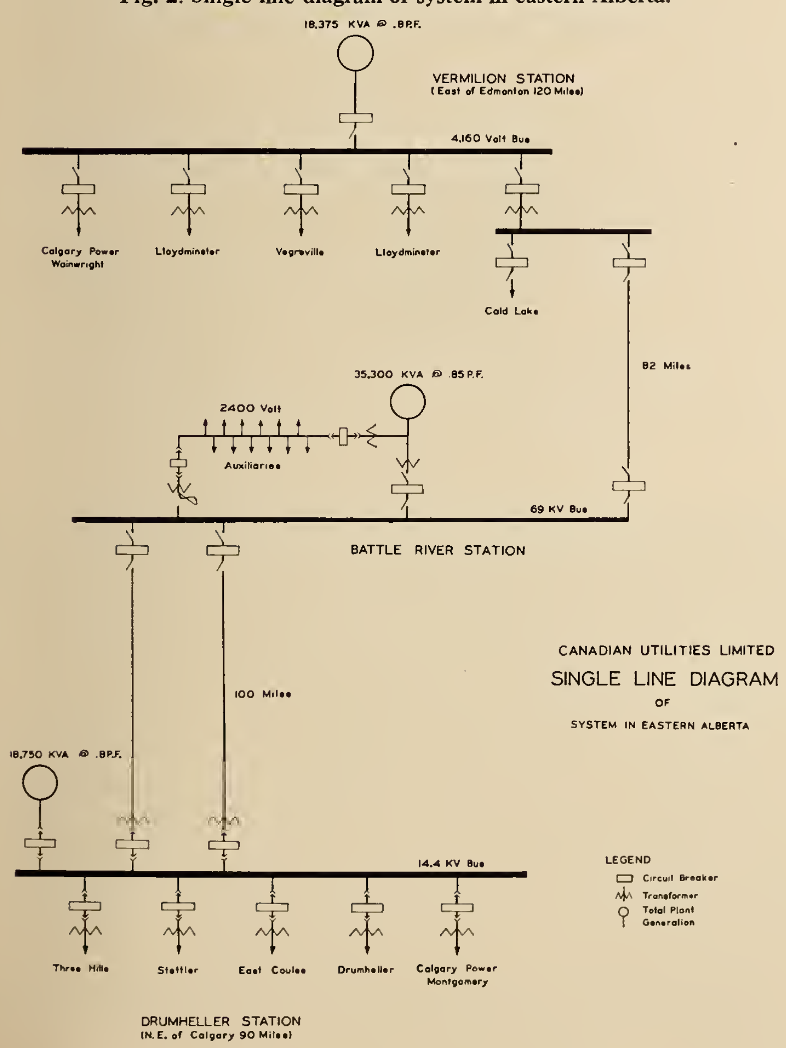
With these considerations it was decided to specify a single pulverized fuel unit. Tenders were called on the steam generator including pulverizers, fans and air heater.

Bidders were asked to supply 3 mills of such capacity that 2 mills could carry 80 per cent of the boiler capacity. The boiler capacity was selected liberally (350,000 lb./hr.) to provide for heating of incoming air and other possible auxiliary uses. It is therefore probable that full load could be carried on the turbo-generator with only 2 mills operating.

Table II.—Analysis of Slack Coal

B.t.u./lb.	8,315	Carbon	49.5%
Moisture	24.8%	Hydrogen	3.5%
Volatile	29.3%	Sulphur	0.4%
Fixed carbon	37.9%	Nitrogen	0.9%
Ash	8.0%	Oxygen	12.9%
Total	100.0%		
Grindability 29 Hardyrove		Ash fusion 2,155°F.	

Fig. 2. Single line diagram of system in eastern Alberta.



Steam Conditions

There was no existing plant at the proposed site of the Battle River station, and therefore there was no requirement to match existing steam conditions. The Drumheller steam conditions were 400 lb. and 825° F. total temperature. It was desirable to select a standard steam condition and, with the size of the unit, two conditions were compared, i.e., 600 lb. at 825° F. and 850 lb. at 900° F. For the expected load conditions there was actually little to choose between the two conditions. The choice was made in favour of 600 lb. at 825° F. largely because it was a smaller jump from the pressures and temperatures to which the staff had been accustomed.

Selection of the size of unit (both turbo-generator and steam generator), selection of method of firing, and selection of steam conditions are the major decisions affecting the design and economy of the plant and selections of auxiliary items, though important, have less effect on the economy of the plant design.

Tests of Coal

Since the Battle River coal had never been burned in pulverized form, several carloads were shipped to Drumheller and burned in the power plant furnaces there. It was hoped to learn something from these tests as to the mill sizes required, temperatures of air to the mills required, fineness for good burning, and any other information which might help design satisfactory equipment for the new plant. These tests were supervised by engineers from Combustion Engineering-Superheater Ltd. who supplied the Drumheller equipment.

In general the tests indicated that the coal was easily burned even if the fineness out of the mill did not meet the requirements necessary for Drumheller coal. Unburned carbon loss, even with coal coarser than 60 per cent through a 200 mesh, was below 0.6 per cent.

Power requirements for the mill increased and mill capacity was found to drop off rapidly if the moisture content of the coal was not reduced below 17 per cent. Little improvement resulted from lowering the moisture below 15 per cent. High mill inlet temperatures were found necessary to accomplish the required drying. It was indicated that temperatures above 600° would be desirable. Temperatures above 800° appeared to add little to the mill performance.

Grindability index was determined as 29. Some compensation for low grindability is obtained from the free burning characteristics of the coal. However, the power requirements for grinding are high, and large mills are required.

The information obtained from these tests was helpful to bidders in electing mill sizes.

Steam Generating Unit

The steam generating unit purchased was a two-drum bent-tube boiler with water-cooled furnace, pendant superheater, tangential burners and tubular air heater. This contract included all draught equipment and ducting from the inlet to the F.D. fan to the louvres on the discharge of the I.D. fans. Mechanical type dust collectors were included.

Some design figures on the unit are listed below.

Heating surface (boiler)	18,400 sq. ft.
Heating surface (furnace)	10,173 sq. ft.
Heating surface (air heater)	82,100 sq. ft.
Full load combustion rate	21,750 Btu/hr./cu. ft.
Air to F. D. fans	368,000 lb./hour
Air to F. D. fans	94,000 c.f.m.
Gas to I.D. fans	194,000 c.f.m.

The unit was provided with eight air-operated, steam blowing, long retractable soot blowers with automatic sequential control. Provisions were made for future installation of wall blowers if these should prove necessary.

Since high temperatures were required at the mills, a very large air heater was supplied with the intention of getting 600° F. air from the heater. Later this design was modified with primary air being taken through additional air heater space to give a full load primary air temperature of 680° F. The air heater is installed outdoors with one side sealed to the plant to form part of the plant wall. Regenerative air heaters were considered and were competitive. If the boiler had been larger no doubt regenerative heaters would have been chosen. It was, however, decided to use the tubular heater because of the absence of moving parts.

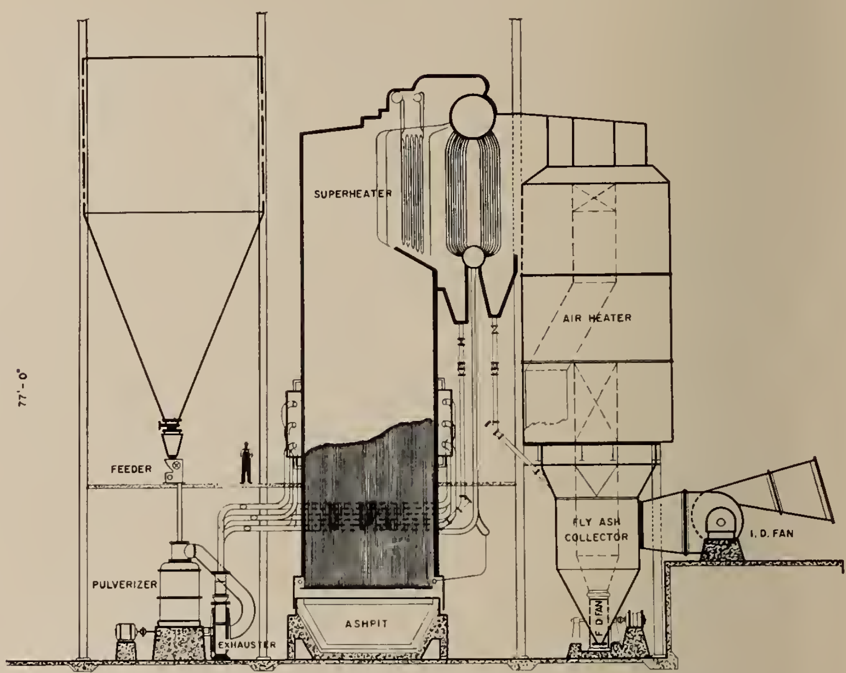


Fig. 3. Steam generator; 350,000 pounds per hour.

The large quantities of air required for the furnace cannot be satisfactorily drawn from the plant during cold weather. If this were attempted the plant would be too cold for the operators and there would be freezing troubles. It is necessary therefore in winter to draw some or all of the combustion air directly from outdoors to the F.D. fan. If this cold air were supplied to the air heater there would be cold areas in the heater in which the gases would be cooled below the dew-point, and corrosion and plugging of tubes would result. Although this condition would be much worse in high sulphur coals, it would to a lesser degree prevail in any plant. A number of ways have been tried to eliminate excessively low temperatures in the air heaters. The incoming air can be heated by steam coils, a portion of the gas can be recirculated, or cold air could be by-passed around the heater. The third method is cheap but results in low air temperatures to the burners and a drop in efficiency. The second method requires modification to the fan inlets for proportioning the admission of gas, requires more fan power, and limits the heating at light loads. The first method adds some draught loss.

At Battle River steam coils were installed to heat the incoming air. The proportion of air to be taken from the plant is determined by manually set dampers in the louvres between the F.D. fan room and the plant and in the outdoor inlet to the fan room. A by-pass damper, which is thermostatically controlled to by-pass air around the heater regulates the air temperature. Control is normally set for 80° F. air to the F.D. fan. Steam to these heating coils is taken from the saturated header and reduced to 200 lb. pressure. Condensate from these heaters is discharged through continuous discharge thermostatic traps to the surge tank in the feed heating system.

Two F.D. and two I.D. fans were called for. The unit is not beyond the capacity of single fans but two fans were specified as some measure of protection against outages. Probably 70 per cent of the turbine load could be carried with one fan out of service. The addition of two fans does complicate automatic control. The F.D. fans have inlet vane control. The I.D. fans have hydraulic couplings and outlet vane control. The latter are located outdoors. Water-cooled sleeve bearings were specified for the fans.

An electrically operated relief valve was installed on the superheater header which is set lower than the main relief valves. This valve takes care of many of the rises in pressure which would normally result in operation of the main relief valves. Since it can be isolated by a gate valve, it can be reseated without taking the boiler out of service. This feature would eliminate some boiler shutdowns resulting from leakage of the main relief valves.

With tilting burners provided, it was not considered necessary to provide dampers in the superheater section or any attemperator control for maintaining accurate superheat temperatures. At very light loads, some falling off in temperature would be expected, but otherwise sufficient range was expected in the burner tilt.

Combustion Equipment

The steam generator is equipped with three tilting burners in each corner of the furnace. One oil torch was supplied for each corner of sufficient capacity to generate 75,000 lb. of steam per hour. Other torches can be added later if it is ever desirable to go completely to oil firing. One coal burner in each corner is supplied from each mill. Some control of steam temperature can be obtained at light loads by selecting the burners to be used. The upper level of burner will naturally give the higher gas temperature through the superheater. This is in addition to the burner tilt control.

Since the coal flame becomes unstable at very light loads, small oil torches (side igniters) can be turned on which play a small oil spray on the coal stream and help to maintain a flame which might otherwise be snuffed out. The igniters are also used to light off the coal when the boiler is being brought into service. Igniters are turned on or off from the boiler control desk.

As stated three mills were called for. The mills supplied are Raymond bowl mills, size 533A, each capable of pulverizing 22,000 lb. per hour of coal with 25 per cent moisture, and 35 grindability index to a fineness of 55 per cent through a 200 mesh screen. These mills are fitted with an integral exhauster which draws the coal-air mixture out of the mill and blows it into the furnace. With one burner in each corner of the furnace, the coal is aimed at the tangent of an imaginary circle in the furnace resulting in high turbulence, which is necessary for proper contact between the oxygen in the air and the carbon in the coal. The mill is under a vacuum which helps to prevent escape of dust.

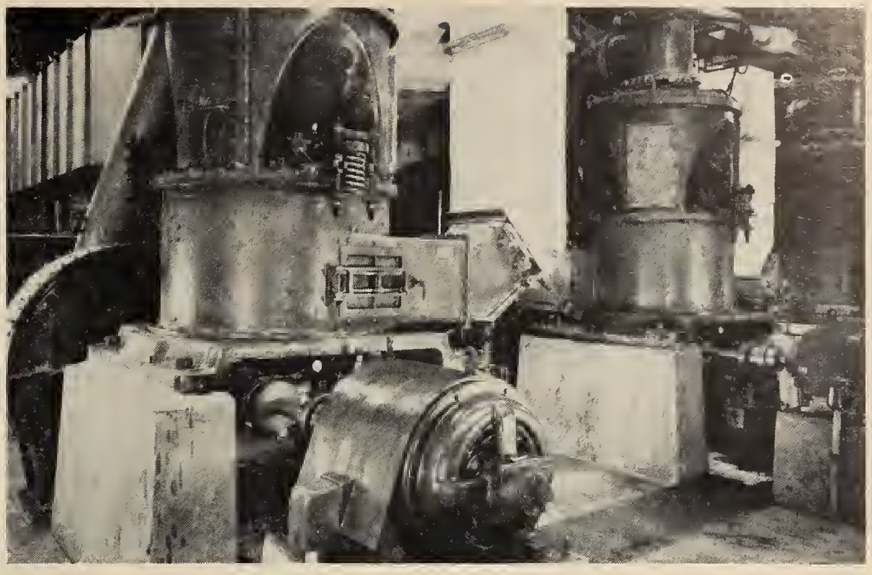


Fig. 4. Raymond ball-mill pulverizer; 22,000 pounds of coal per hour.

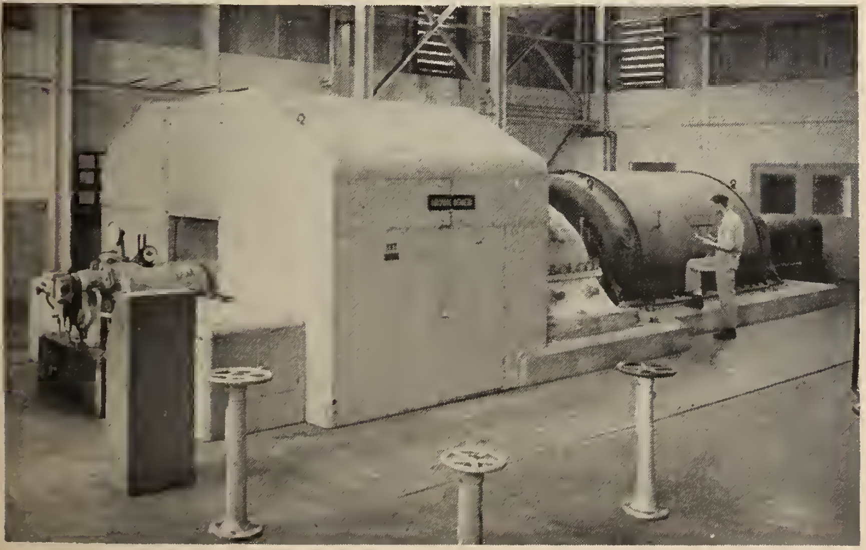
Coal is fed to the pulverizer from a feeder placed on the operating floor above the pulverizers. Coal is measured by pockets in the rotating wheel of the feeder. The rate of feed is then determined by the speed at which the feeder rotates.

In the operation of a pulverizer the coal remains in the mill until it is fine enough to be borne out by the air stream. With the coal at Battle River it is necessary to dry the coal considerably in the mill and high air temperatures are required — in the order of 680°.

The coal burns in suspension in the furnace, being mixed with additional (secondary) air which is admitted around the burner. The proportioning of coal to air is done automatically by the combustion control equipment. The combustion arrangement is standard except for the special provisions to get high air temperatures to the mills.

When the gas leaves the air heater, the induced draught fans deliver it to the chimney which is located a short distance from the plant. An insulated steel breeching connects the I.D. fan discharge to the chimney.

Fig. 5. Turbo-generator; 32,000 kilowatts.



Chimney

The chimney has an inside diameter of nine feet at the top, 15 feet at the bottom, and is 180 feet high. Radial brick was selected though concrete was competitive. The chimney was lined with radial brick for about 40 feet of its length. The design of the chimney was selected to give sufficient draught to overcome chimney losses at full load.

The Turbo-Generator

The turbo-generator installed at Battle River was manufactured in Switzerland. Nominally rated at 30,000 kw. at 80 per cent power factor, it has a capability of 32,000 kw. with power factor not less than 90 percent. The short circuit ratio of the alternator is 0.7.

The turbine is single cylinder with impulse followed by reaction blading. It has four bleed points for feedwater heating. It was designed for 28.5 in. vacuum. Since fuel is cheap and condensing water ultimately limited, it did not appear economical to go to higher vacuum for greater efficiency.

The turbine is connected by solid coupling with a 35,300 kva. air-cooled alternator. A direct connected exciter with pilot exciter is used. Hydrogen cooling was not specified for the generator, though American practice would favour such cooling for a 30,000 kw. unit. For European machines the extra efficiency from hydrogen cooling would not have shown an operating saving with the low priced fuel. Following the underlying principle of keeping the plant as simple as possible it was decided to specify only air cooling.

The turbine exhausts into a two-pass divided surface condenser with a cooling surface of 26,800 sq. ft. The tubes are of Admiralty metal and are 1 in. in diameter. The tube plates are of steel. This latter selection was made after some hesitation but it is not expected that cooling water conditions will result in tube plate corrosion.

Condensing water requirements with water at 70°F. are 27,000 Imperial gallons per minute. This drops to 15,000 gallons per minute in winter with cooling water at 40°F.

Steam is brought to stop valves on both sides of the turbine. Stop valves are followed by governing valves which control the admission of steam to the turbine. For light loads partial admission of steam is used, with additional nozzle sections being brought in as the load increases. Governing is effected by oil under pressure with action initiated from a flyball governor. Normal oil pressure is maintained by direct gear-driven oil pump. An emergency electrically driven pump will take over in case of a dangerous drop in oil pressure or during start-up and shutdown procedures. A steam driven oil pump is also available.

Special protective features incorporated in the unit are, centrifugal type of over-speed tripping device, low vacuum load rejection and trip, and axial displacement alarm and trip. All the emergency tripping devices act through a valve which releases control oil pressures under the stop valves causing them to shut instantly. If for any reason the vacuum should fall below 25 in. of Hg the load rejection device will allow a certain leakage of oil out of the governing system permitting the governing valves to move towards the closed position, thus reducing the load carried by the machine. Should the vacuum continue to decrease to a dangerous point, the low vacuum actuates the emergency shutdown device and causes a complete shutdown of the machine. The turbine cannot be restarted until the trip is reset and the normal starting procedure is followed.

The axial displacement alarm warns of axial movement of the shaft within narrow limits. If the movement exceeds these limits the second stage of the protective equipment will initiate a complete shutdown.

The normal governor of steam turbine has about 5 per cent droop in the speed characteristic from zero to full load. That is, if the governor is adjusted at full load to 3600 rpm and full load was slowly applied without adjusting the governor, the speed would drop about 5 per cent. This assumes the unit is not connected to an electrical system. Normally the operator would correct this droop by ad-

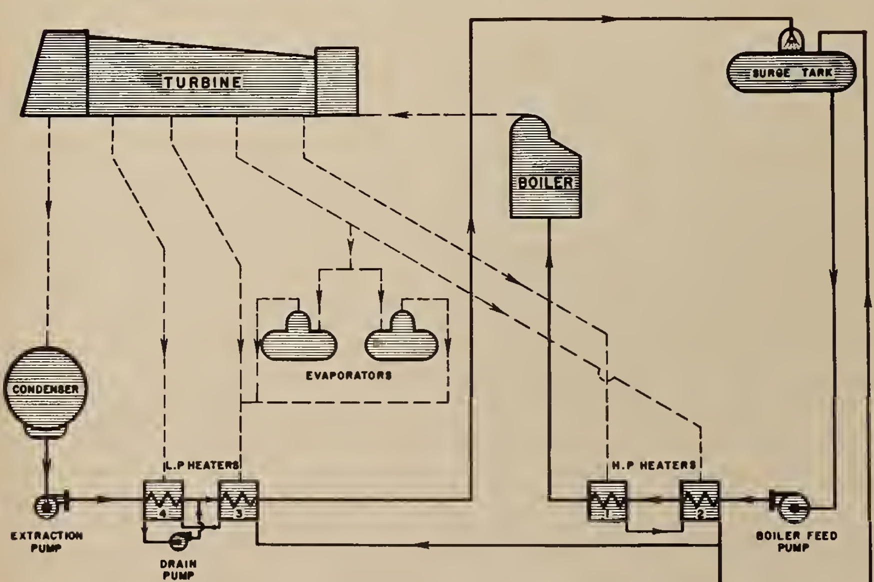
Table III.—Make-up Water Analysis

	Sample Taken in March	Sample Taken in May
Total dissolved solids	1,020	270
Total hardness (as $CaCO_3$)	510	130
Calcium hardness (as $CaCO_3$)	460	88
Magnesium hardness (as $CaCO_3$)	50	42
Total alkalinity (as $CaCO_3$)	650	155
Free CO_2	190	8
Chloride (as NaCl)	18	4
Sulphate (as Na_2SO_4)	155	56
Silica (as SiO_2)	14	7.2
Iron (as Fe)	4.2	4.6
Turbidity (as SiO_2)	2.0	8.0
pH	7.2	7.8

Table IV.—Probable Water Analysis After Treatment

Cations	PPM as	Raw Water	Treated Water
Calcium	$CaCO_3$	165	0–1
Magnesium	$CaCO_3$	40	0–1
Sodium	$CaCO_3$	105	132
Anions			
Bicarbonate	$CaCO_3$	260	0
Carbonate	$CaCO_3$	0	25
Sulphate	$CaCO_3$	43	103
Chloride	$CaCO_3$	7	7
Total hardness	$CaCO_3$	205	0–2
M.O. alkalinity	$CaCO_3$	260	25
Free CO_2	CO_2	21	—
Silica	SiO_2	7.5	
Total dissolved solids		365	

Fig. 6. Flow diagram.



justing the governor setting. This droop is desirable in order that machines may be operated in parallel without one or the other machine attempting to grab all the load on the system. With a steam unit connected in a system with a large hydro unit, there is a tendency for steam units to be more sensitive to load changes and they may become overloaded. A device has been added to the Battle River unit which will permit adjustment of the drooping characteristic even when the machine is in operation. This device will permit adjusting the droop to as high as 20 per cent. This is a recent development which, it is expected, will assist in the operation of this station while paralleled with the Calgary Power system.

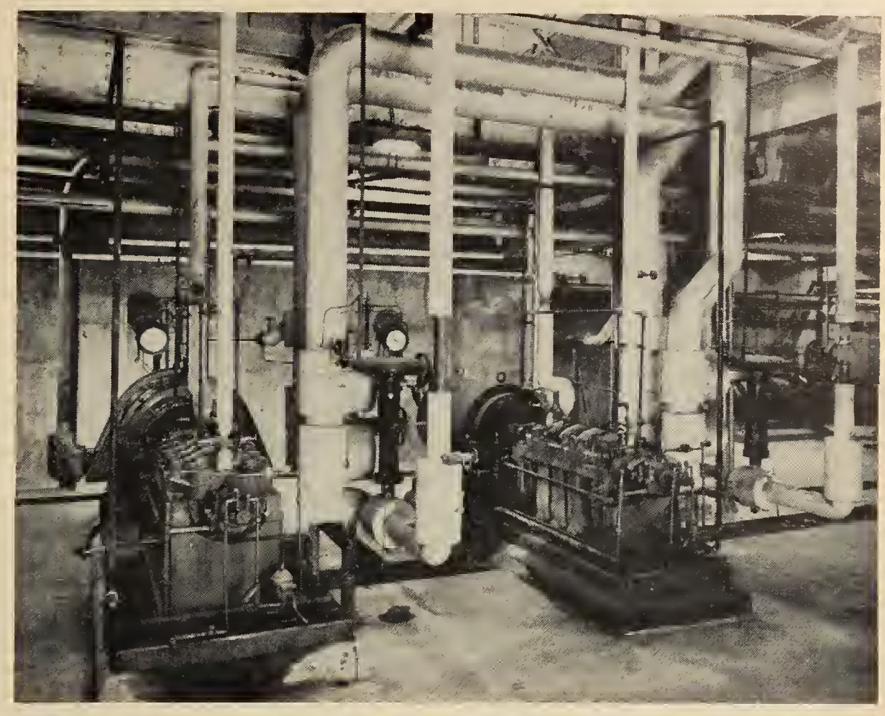


Fig. 7. Boiler feed pumps; 600 h.p.

Feed Heating and Make-up

The feed heating system was included as part of the turbine supply. It is a four-stage system with two low pressure and two high pressure heaters. Condensate from the condenser is pumped by the extraction pump through the two L.P. heaters and sprayed into a surge tank located near the top of the boiler plant. This surge tank is vented back to the condenser and the surge tank acts as a deaerator though most of the deaeration takes place in the condenser. Water from the surge tank returns to the boiler feed pump where it is pumped through the high pressure heaters and into the boiler drum. The final feedwater temperature is 360° F. at full load.

Raw water for "make-up" is first treated in a hot lime-zeolite process softener. It then goes into a storage tank or into the evaporator. There are a number of processes to choose from for treatment of boiler feedwater make-up. The water can be conditioned by evaporation alone; by demineralization alone; or by acid zeolite, split stream, or hot lime-zeolite with or without evaporation. Economically for this station the choice lay between the hot lime-zeolite process or no pre-treatment ahead of the evaporators. On a future installation further study will be given to the possible elimination of the evaporators.

The make-up water is drawn from the storage pond in the Battle River. The analysis of this water will vary from season to season. Two analyses are given in Table III to give some indication of the range in quality.

A probable analysis after treatment is as shown in Table IV (based on an average raw water).

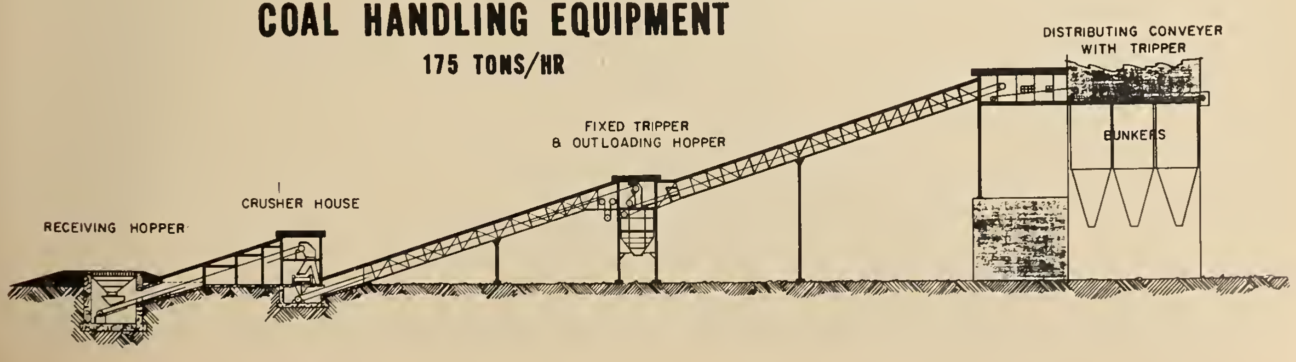
Chemical costs for pre-treatment of water are in the order of 4 cents/1000 gallons.

Steam for the evaporators is taken from the second bleed point on the turbine. This same bleed point serves the first high pressure heater. The evaporated make-up enters the second low pressure heater and along with condensed steam cascades back to the first low pressure heater. It is then passed back to the condenser at very light loads or is picked up by the drip pump at heavier loads and introduced into the feedwater line on its way to the surge tank.

The level in the surge tank is float controlled. If it reaches the top limit an electric valve is opened permitting condensate to go back into the storage tank. If the low limit is reached another valve is opened which permits water from the storage tank to be drawn back into the condenser.

The evaporators are single effect. Cupro-nickel tubes were used as it was felt that copper tubes might not resist corrosion from the high pH water reaching the evaporator. The pH of the make-up water would be of the order of 10.2 to maximum 12.

Fig. 8. Coal handling equipment; 175 tons per hour.



Provisions were made for the feeding of such other chemicals as are necessary for delivering a satisfactory water into the boiler drum.

Boiler Feed Pumps

Selection of boiler feed pumps involves size and number of units, type of drive and control.

In Battle River it was decided to use two 100 per cent capacity pumps. It was first intended to use one pump with direct constant speed motor drive and one turbine driven pump. A hydraulic coupling was considered for the motor driven pump but the coupling did not show fuel savings sufficient to justify its cost. It was attractive from its operating characteristics but it was finally rejected. The turbine drive was finally rejected also mainly because the turbine manufacturer did not wish to handle the large quantity of exhaust steam from the turbine in his feed heaters, and the losses resulting if steam were exhausted into the condenser would have been large. The result was that two direct connected motor driven pumps were purchased. The motors are 600 h.p. and are two of the larger auxiliary motors in the plant.

Condensing Water

The Battle River is a very small river in which the flow may vary from zero to perhaps 5000 c.f.s. during floods. In order to be assured of water at low flows a dam was constructed across the river and a storage pond created.

A pumping plant was constructed beside the cooling pond. Two vertical mixed flow pumps were installed, one of 27,500 I.g.m. capacity and one of 13,000 I.g.m. capacity. The smaller pump was designed to provide cooling water for full load conditions during winter while the larger one was designed to provide full load summer requirements with the water at 70° F.

The large pump is driven by a 700 h.p. motor and the smaller one by a 350 h.p. motor. Both are full voltage starting.

Revolving screens are installed in each pump intake well.

The pump station is remotely operated from the control desk in the power plant. Alarms will indicate high bearing temperatures on the motors, or low water on the downstream side of the screens. In the latter case the operator can start up the screens and turn on the screen wash water.

Fig. 9. Ash handling equipment and chimney.

The pumping plant is about 600 feet from the power plant. Forty-two inch steel pipe carries the water to the condenser. Wood stave pipe was used for the discharge from the condenser to carry the water beyond the power plant grounds. From there a steel flume conducts the water about 3000 feet upstream at which point it returns to the storage pond. At periods of low flow evaporation will aid in maintaining a reasonable cooling water temperature.

Coal Handling

As previously stated coal will be delivered to the plant by truck. The coal may be anything from pea slack to mine run. Slack coal will be delivered at the Battle River site at the rate it is produced at the mines. This may be faster than the plant is consuming the coal. In such cases, the coal will have to be stocked.

Various types of trucks will be used by the coal truckers to deliver their coal, including end dump trucks and large centre dump coal haulers. Coal will be reclaimed from the stock pile by tractor-hauled scraper. The receiving hopper is required to accommodate both mine run and slack coal and all of the various vehicles mentioned. The major vehicle considered during design provides for driving this hauler across the hopper and dumping any coal up to 16 in. size into the centre strip of the hopper. End dump trucks back on to the hopper and dump into the centre strip. It was found desirable to place vibrators on the receiving hoppers to ensure free flow of coal during extreme weather conditions.

Because of the length of hopper required to accommodate a 40-ton hauler, the receiving hopper was constructed as a double hopper. Reciprocating feeders move the coal from the bottom of these two hoppers on to a 42 in. belt which raises the coal to a crusher at ground level. The receiving hopper, crusher, and weigh scales are all close together at ground level. This arrangement was intended to save man-power in operation.

The crusher supplied was a double-rotor ring-type Knittel crusher with each rotor driven by a 50 h.p. motor. Coal from the crusher is hoisted by a 24 in. belt to the top of the plant where it is discharged into travelling tripper for distribution into the bunkers.

For stocking out coal a fixed tripper is placed part way up the hoisting conveyor, and by manipulation of a flop gate coal can be diverted into the stocking out hopper. From there it can be hauled to the stock pile.

The coal handling system was designed for 175 tons per hour. This would handle the coal for a continuous load of 60,000 kw. in less than eight hours. Further capacity could be obtained by higher belt speeds. but it will also probably be necessary to take delivery over longer periods than 8 hours in order to accommodate the mines. The coal is crushed to 1 in. minus.

For stocking, compacting and reclaiming coal, three pieces of equipment were purchased. These were a D7 tractor, a front end loader, and a seventeen yard scraper. The tractor does most of the compacting. Reclaiming can be done by tractor and scraper or by front end loader and truck. Run of mine coal will be crushed before stock piling.

Ash Handling

The ash handling system is of the vacuum type. Sluicing was considered but since there was sale possible for the ash, it was decided to use the dry removal system. A system for handling 12 tons/hour was installed, with a steam exhauster for producing the vacuum. The evacuating equipment was placed outside on top of a 100-ton glazed tile storage silo.

The system works on the intermittent principle. An air washer is used in the discharge from the ejector. Selection of steam exhauster over a Rootes blower for producing vacuum was based strictly on price. Live steam at 600 lb. and 825° F. is used.

A dustless unloader was installed for tranferring ash from the hopper to the truck. Sufficient water is added in the unloader to prevent the dust from rising from the ash.

Provision is made for keeping the coarse ash from the furnace bottom separate from the fly ash in the collector. The silo is partitioned and a remote operated gate permits directing the ash into the proper compartment of the silo. At the time this was planned, it appeared there would be a market for fly ash but possibly none for the coarse ash.

Control Equipment

The control is largely pneumatically operated. Combustion control operations are initiated by a pressure sensitive relay acted on by the main steam pressure. A drop in steam pressure is converted into a change in control air pressure which starts the

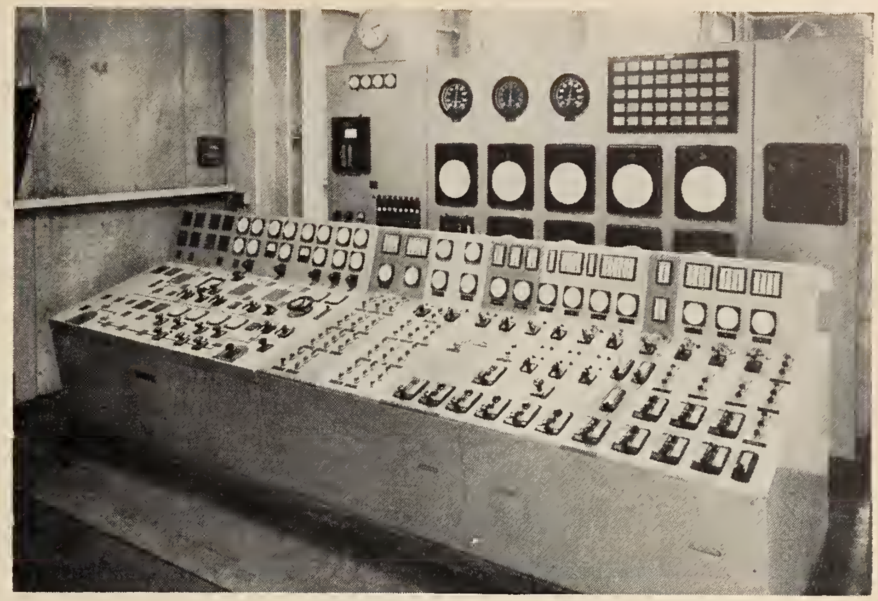


Fig. 10. Substation turbine generator boiler control equipment.

necessary corrective steps in order to restore the steam pressure to normal. To produce more steam, more coal and air must be fed into the boiler so the control pressure changes are transmitted to the fan dampers, the hydraulic couplings, the exhauster dampers and coal feeders in order to bring about the increased heat production. Corrective influences are fed into the control system to maintain the proper coal/air ratio for good combustion.

The controllers performing the actual moving of dampers, valves, etc. are pneumatically operated cylinders with suitable linkage to produce the desired movement.

Since the mills are started by the operator, the boiler may be operating with one, two or three mills at one time. It is impossible to cover the full range of boiler load under these conditions and reduction from full load to quarter load requires taking off two mills. In order that the load may not go beyond the limits of the mills in service, limiting relays are a part of the control equipment. These are set to cover the limit which the automatic control can handle for the number of mills in service. For example, if three mills were in service the low limit on the control might be set at 150,000 lb. of steam per hour. If the steam requirements fell below that it would still not be safe to cut the coal and air supply below a certain point. Thus more heat would be supplied than required. The pressure would rise and would eventually open the safety valve. By this time the operator could take off one mill and reset his load limiting relays. This may seem undesirable, but it is a safe arrangement whereas cutting the load on three mills to a dangerous point would snuff out the fires and might result in an explosion.

Automatic control of the steam temperature within the limits of the equipment is provided by converting the change in steam temperature to a change in control air pressure to produce a change in the burner tilt. The change in air flow is used to anticipate a probable change in steam temperature and thus initiates the corrective action as early as possible.

Feedwater is controlled by similar equipment which receives indications from steam flow, feedwater flow and drum water level. The control attempts to keep steam and water flow even, but drum level acts as a corrective influence to restore any departure from normal level. The actual control of the flow of feedwater is by regulating valve. Where hydraulic couplings are used on feed pump drive, the setting of the coupling is altered to change the rate of flow.

The control switches for the pneumatic control system and for the various electrical switches are installed on a control desk mounted between the boiler and turbine on the operating floor. Indicating instruments occupy a portion of this desk. A vertical panel in front of the desk contains some of the larger indicating instruments and the graphic instruments. From this point the operator can control all the normal operation of the boiler, turbine and plant auxiliaries.

(*Continued on page* 78)

Forces Involved in Pulpwood Holding Grounds

I. Transverse Holding Grounds without Piers

R. J. Kennedy, M.E.I.C.

Associate Professor of Civil Engineering, Queen's University, and Supervisor, Project RC-12, Pulp and Paper Research Institute of Canada.

Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June 1957

The pulpwood holding ground is the link between cheap river transport of pulpwood and the mill yard, but very little has been known of the forces which its structures should be designed to resist. The Pulp and Paper Research Institute was asked by the industry to investigate the problem and this report covers the first phase of the project.

A survey of field installations and practice in eastern Canada was made. The objectives of the study were then defined, and a combined laboratory and field investigation begun. Methods of calculating the total force exerted by the water on the wood in a transverse holding ground, and the division of that force between the shores and the boom system, have been developed. The rather complex solution is presented in nomographic form and a typical design problem is worked out. Finally, in Appendix 2, the force measured on a large holding ground in 1956 is compared with that calculated from the nomograph for the same conditions; the agreement is within seven per cent.

SINCE THE days of squared timber rafts, Canadian forest products have been floated to market with the force of gravity supplying much of the necessary power. Most of the vast quantity of pulpwood produced in Canada today proceeds down creeks and rivers and is held for a time in pulpwood holding grounds, a single one of which may contain millions of dollars worth of wood. Very large sums of money are spent on the construction and maintenance of the booms, piers and anchors of these holding grounds; but comparatively little is known of the forces, caused by the flow of wind and water past stationary pulpwood, which these structures must resist. Occasionally, under severe conditions, structures fail, resulting in the escape of quantities of valuable wood. On the other hand, many structures are built so that they possess strength far in excess of that required for a reasonable factor of safety. With this in mind, the pulp and paper industry asked the Pulp and Paper Research Institute of Canada to investigate the whole question of pulpwood holding grounds, and in May, 1952, a Steering Group met and laid out a preliminary programme. A three-man team was formed and commenced working on the problem under the guidance of the Steering Group.

The first steps taken by the project team were to conduct a literature survey and to send out questionnaires requesting basic data on holding grounds. When the information received had been organized, a field inspection of about forty holding grounds in eastern Canada was made.

It became apparent that river holding grounds are of two main types:

(*a*) Transverse — with a boom stretched across the river at a sharp angle to the current.

(*b*) Parallel—with the boom nearly parallel to the main current and the banks, usually to permit navigation.

Illustrations of these two types are given in Figure 1.

In addition, there are lake holding grounds and holding grounds in tidal waters, each with their own characteristics.

The function of each type of holding ground is the same—to hold wood stationary against the forces exerted by water and wind. The design of safe and economical holding grounds requires a knowledge of the magnitude of the forces which will act on the booms, piers, ties and anchors. The present study is concerned with the determination of these design forces for given physical conditions.

River holding grounds, which outnumber all others, are mainly affected by water flow. The forces caused by wind are independent, and may be added vectorially to those caused by water. The investigation of wind forces was, therefore, postponed until a later stage.

Considering only the action of the water, there are three basic factors governing the magnitude of the downstream thrust, T_1, which is imposed upon the jam of pulpwood. These are:

(*a*) the quantity of wood held,

(*b*) the maximum stream flow,

(*c*) the physical characteristics of the stream.

All of these may be measured or estimated with some degree of accuracy, and the first part of the problem involves the discovery of the relation between T_1 and these factors.

The total downstream thrust imposed upon the wood by the water is then transmitted to, and ultimately resisted by, the shores and various structures of the holding ground. The second part of the problem is the determination of the ratio in which T_1 is divided among these resisting elements.

Because the measurement of pertinent variables at full scale is difficult and their manipulation usually impossible, it was decided to use scale models, which could be controlled easily, to determine relationships over a wide range of conditions. The results (suitably corrected for scale) could then be spot-checked by field measurements on actual holding grounds.

Since the transverse holding ground without piers in a straight stretch of river promised to exhibit the simplest relationships among the variables involved, it was chosen as the subject of the first stage of this study and of this report.

Analysis of Forces on a Transverse Holding Ground

Pulpwood floating into a holding ground is stopped by the boom. At first, succeeding sticks tend to build back one layer deep. Then some are forced under at the upstream edge of the jam and these roll and tumble along the undersurface of the floating logs until they come to rest in a hole or crevice. As more wood arrives, the downstream thrust increases. The jam buckles and consolidates, becoming even deeper, and pushes against the boom system and shores.

A search of the literature concerned with pulpwood holding grounds revealed several equations dealing with the forces on booms and piers. All contained empirical coefficients and none seemed to be generally applicable. It was therefore necessary to analyze the forces in the system in order to determine what measurable quantities could be used to define them.

While the total force exerted on a pulpwood jam by water is dependent upon the three general factors mentioned, quantity of wood, stream flow and physical characteristics of the stream, the problem cannot be studied on this basis because the factors are not simple independent variables. There is, for instance, no single measurement which will describe the width, depth, roughness and alignment of a stream. A more detailed approach relating *independent* variables to the force T_1 must be used.

The probable maximum discharge for a given stream may be determined from flow records and hydrologic studies. After detailed surveys have been made, the surface velocity and the mean velocity of the stream corresponding to this maximum discharge may be calculated. Assuming that a relation exists between the surface velocity and the depth to which wood of *given characteristics* will jam, then it should be possible to predict the depth of the jam. As the approximate quantity of wood and the width of the stream are known, the length of the jam which is to be held can be estimated closely. This brings us to the point where we have available for use the measurements shown in Fig. 2, in which

h_1 and h_2 = the depth of water in feet at sections 1 and 2
V_1 and V_2 = the mean velocity in feet per second at sections 1 and 2
V_s = the surface velocity in feet per second
d = the mean depth of the jam below the surface of the water in feet
L = the length of the jam in feet.
b = the width of the stream in feet

If a simple boom is placed across this straight uniform reach of a stream and pulpwood floated down, a jam of length, L, and depth, d, will form. If the stream bed is considered to be horizontal and frictionless, we may expect that the depth of water h_2 will be greater than h_1 in order to provide the force necessary to drive the water past the rough underside of the jam.

If the section surrounded by the heavy black line (Fig. 2) is taken as a free body, one foot in width, then the horizontal forces acting on it are:

F_1—the hydrostatic force at 1
F_2—the hydrostatic force at 2
F_3—the force exerted on the boom by its ties
F_4—the reaction to the force required to change the momentum of the water between 2 and 1

Since the free body is stationary these forces must be in equilibrium.

$$F_2 - F_1 - F_4 = F_3 \qquad \ldots\ldots(I)$$

F_3 is the external force necessary to hold the pulpwood jam stationary, and its evaluation is the first step in the overall problem.

Taking the weight of water as w pounds per cubic foot and $h_2 - h_1$ as Δh, then

$$F_1 = \left(\frac{w}{2}\right) h_1^2$$

$$F_2 = \frac{w}{2}(h_1 + \Delta h)^2$$

$$F_3 = \frac{w}{2}[(h_1 + \Delta h)^2 - h_1^2] - F_4 \qquad (II)$$

$$F_4 = h_1 V_1 \frac{w}{g}(V_2 - V_1)$$

where g is acceleration caused by the force of gravity.

Fig. 1.

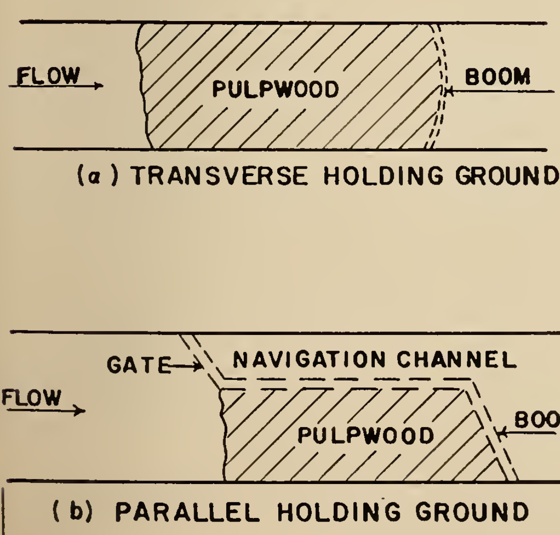
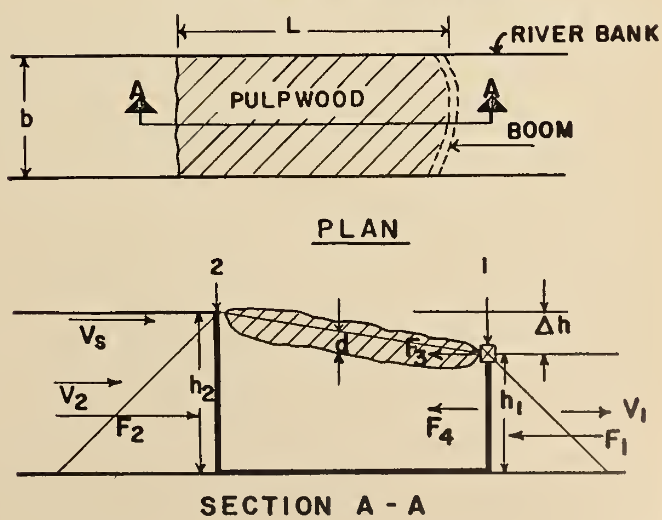


Fig. 2. Transverse holding ground



Though F_4 may be evaluated as above, it is not necessary to do so in the final development because it is possible to eliminate it completely at a later stage.

At this point, for a stream with frictionless shores, F_3 is equal to T_1, the downstream thrust, and may be calculated, provided h_1, V_1 and Δh (the head of water backed up by the jam) can be measured or otherwise determined.

Plan of Attack

It was necessary to evaluate the dependent variable F_3 in terms of the independent variables such as the depth of the water, velocity, etc. Because F_3 is a force with the dimension of pounds, it would not fit into the type of plot desired. Also, even in the analytical development it proved more convenient to use the quantity Δh ($h_2 - h_1$ for a frictionless river bottom, and which is directly related to F_3 in equation (II)) instead, as an intermediate dependent variable. Since at that time no analytical method of evaluating Δh in terms of the independent variables was known to be applicable, the project team went ahead on the basis of scale model experiments. It seemed that Δh was probably a function of h_1, V_s, L and d. There was a possibility that d was dependent on V_s, but it was decided to treat it as an independent variable until more information was available.

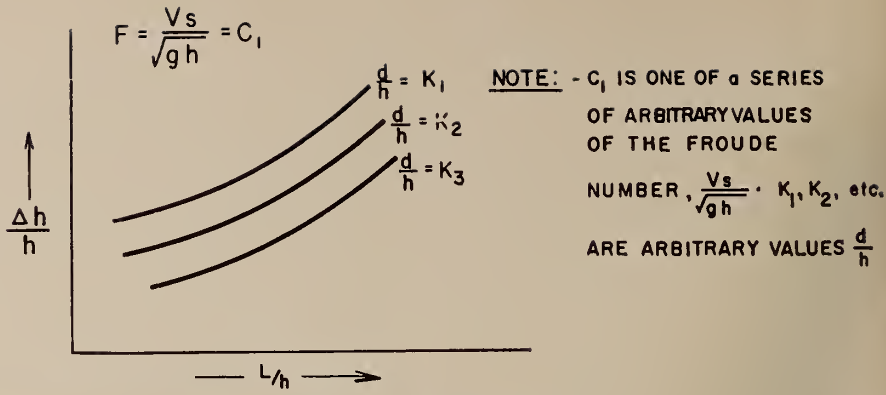


Fig. 3. Proposed Δh plot.

Fig. 4. Model jam and laboratory jam depth gauge.

Fig. 5. Tension test bar and strain indicator.

If $\Delta h = f(h_1, V_s, L, d)$ ......(III)

then these five variables may be grouped into four dimensionless ratios. The most promising arrangement appeared to be

$$\Delta h/h = f_1(d/h, L/h, V_s/\sqrt{gh}) \quad ..\text{(IV)}$$

The parameter $V_s/\sqrt{gh}$ is a form of the Froude number.

It was hoped that the parameters could be plotted on a series of charts of the type shown in Fig. 3. A separate chart for each value of F would be required.

Since full scale field tests are difficult to conduct and very expensive, the plan called for extensive use of scale model tests in the laboratory to build up these curves. The independent variables h_1, V_s, d and L were to be controlled by the operator, and the dependent variable Δh measured. Though not necessary for the analysis so far developed, the force on the boom, F_3, was measured also. When frictionless shores were used, T_1 was equal to F_3, and it was possible to check the accuracy of the measurement by means of equation (II). When ordinary shores were used, comparison of the computed T_1 and the measured F_3 provided useful data for the study of the division of force between boom and shores.

Method of Attack

Since this paper is intended primarily to delineate the problems faced and to present results obtained from the first phase of the work, the actual procedure is given here only in outline with a few details of some unusual features.

The first model work was done at the National Research Council Hydraulic Laboratory in Ottawa. After preliminary trials in an available two foot wide flume, a scale of 1 : 20 was selected and a new four foot wide flume was designed and constructed. The scale of 1 : 20 was chosen because it was believed to be the smallest at which surface tension did not seriously affect the behaviour of the model logs, and the smaller the scale the wider the range of conditions that could be investigated without making the apparatus excessively large. The model logs themselves after much trial and error, were made from oak dowel stock manufactured with dull cutter knives. The resulting "logs". 0.4 in. by 2.4 in. representing 8 in. by 4.0 ft. sticks in the field, were about as rough as pulpwood with the bark on. After they had been soaked in spar varnish and dried they had approximately the same density as green spruce. The varnish made them sufficiently impervious to retain this density for several weeks of intermittent soaking and drying.

Standard laboratory practice was used to control the water levels and discharge. Because of the very flat water surface slopes encountered, it was necessary to develop gauges and techniques capable of measuring differential levels to 0.001 inch. Since the bottom of the flume was horizontal and smooth, but not frictionless, the differential heads measured had to be adjusted to eliminate the effect of the natural slope of running water in order to get the Δh required for plotting.

A cantilever beam, with SR-4 strain gauges as measuring elements, was developed to measure the pull of the jam. The measurement of the total force acting on the jam required that friction between the flume walls and the wood be eliminated. This was accomplished by isolating the jam from the flume with floating walls which were supported by almost frictionless rollers. Both the boom and the floating walls were attached to the force measuring apparatus.

The glass walled plywood flume which was built at NRC was 4 feet wide by 24 feet long; a later flume, used at Queen's University, was 6 feet wide and about the same length. Both had accurately levelled rails on top. The depth of the jam was measured by means of a horizontal arm supported from a carriage which travelled on these rails, as shown in Fig. 4. The current velocity was measured by means of Bentzel tubes or cube-tipped pitot tubes, also supported from the carriage.

The measurement of the same variables in the field was much more difficult. The force on the boom was measured by tension test bars placed between boomsticks and in all the supporting wire rope and chain guys to piers and shore anchors. These bars, developed at the Institute, consisted of suitably machined 65 ST aluminum bars to which SR-4 strain gauges had been bonded as measuring elements. Two layers of rubber were vulcanized onto the bars to provide waterproofing and shock resistance. Electronic recording equipment was used to provide a continuous record of the loads on the various parts of the boom.

The depth of pulpwood jams in the field had been estimated many times, but few records could be found of actual measurements. A jam depth gauge (Fig. 6) was developed to make this measurement, and later a technique for making a representative survey was worked out.

The velocity downstream of the boom could be estimated easily by using a standard current meter, but the velocity underneath a heavy jam required a special instrument which could be poked down through small openings. The cube-

Fig. 6. (top) Jam depth gauge

Fig. 7. Water level recorder.

tipped pitot tube, which gives almost twice the differential that a simple pitot tube supplies, proved satisfactory. However, for light jams, where holes could be found, the current meter was preferred. The positions at which various readings were taken and a map of the holding ground were obtained from a stadia survey. In many instances the men on the jam taking measurements encountered soft areas which would not support them, and light boards had to be used in the manner of skis.

The water levels and differential heads were obtained from direct reading water level recorders mounted on portable stilling wells, as shown in Fig. 7. An accurate level survey was required to tie in the readings of these recorders.

Depth of Jam

The deeper the jam of pulpwood, the greater is the force exerted on it by flowing water. The shallower the stream, the larger is this increase in force with depth of jam. It was necessary, therefore, to determine as early as possible the depth to which a jam would form under particular conditions.

In hydraulic model work it is often impossible to keep all the variables in the proper ratio. When this is the case, the practice is to keep the most important variables in the correct ratio, and to allow those judged to be of lesser importance to assume other values. The results obtained may not be quantitative where the secondary variables have a large effect.

As the water in a stream is forced past a pulpwood jam by gravity, conditions in the model and prototype may be expected to be similar when the Froude numbers are the same. In all model tests the velocities were adjusted so that the Froude number would be identical with that of the corresponding field condition.

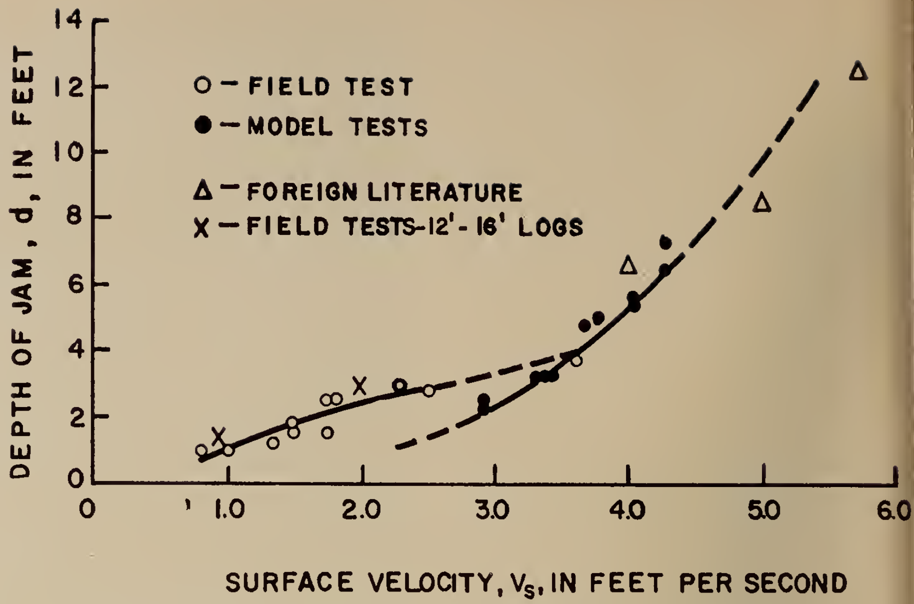


Fig. 8. Surface velocity *v*. depth of jam (when jam is forming).

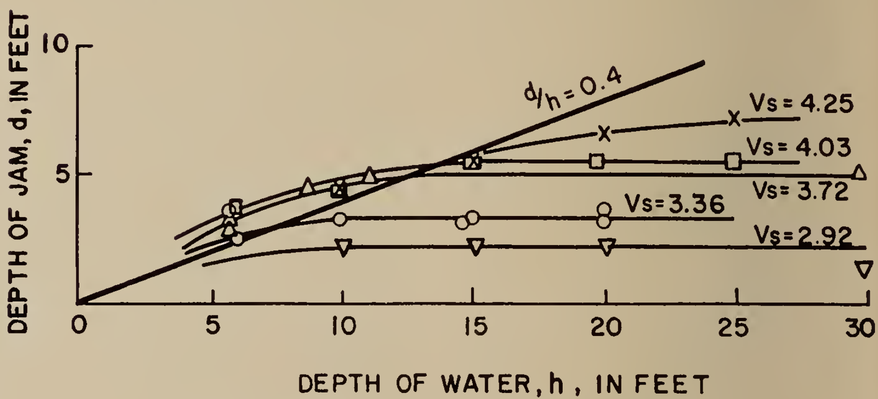


Fig. 9. Limit of d/h under normal conditions.

Figure 8 shows that model and field test results agree for velocities above about 3.5 feet per second. For lower velocities the field jams are relatively deeper. Apparently the consolidation or buckling which occurs in long field jams is not present to the same degree in short model jams. For higher velocities, something approaching full consolidation occurs in the model and the depths of model and field jams correspond. Twelve and sixteen foot wood may form even deeper jams than four foot wood, as is indicated by the points shown on Fig. 8.

The laboratory tests also showed that there is a maximum depth of jam for a given depth of water (Fig. 9).

When the obstruction ratio, d/h, exceeded about 0.4, the velocity underneath the jam became great enough to scour away wood. Then the depth of jam indicated in Fig. 8 for a given velocity could not be obtained. No field verification of this phenomenon was obtained, and indeed there are records of field jams that went right to the bottom of the stream. These must have occurred where long logs wedged themselves between the river bottom and the jam, or in some other unusual circumstances. It would be dangerous to attempt to hold four foot wood in a swift, shallow stream by means of a conventional boom, as the loss of wood under the boom might be large.

On the basis of Fig. 8, the depth of jam could be regarded as being dependent on the surface velocity and the term d/h could be eliminated from the analysis. However, if this were done, the final results would be applicable only to the case where the jam is formed at the maximum velocity. This is the most severe condition and the one for which structures should be designed: but the wood usually arrives in the holding ground before the velocity has reached its peak, and for verification of the development it is necessary to be able to calculate the forces corresponding to actual field conditions at the time a measurement is made. In addition, it appears that wood of unusually high density forms exceptionally deep jams and that twelve and sixteen foot long wood forms deeper and rougher jams than four foot wood.

Because the d required for verification computations does not often correspond to that for maximum velocity, and because in design computations the engineer may wish to increase the d obtained from Fig. 8 to allow for the effect of longer or denser wood, it was decided to continue to handle the depth of jam as an independent variable.

Model Limitations

The model logs did not jam properly at the very low velocities required for small Froude numbers in the flume. In addition, since L was limited by the length of the flume, large L/h values could not be obtained. If h was reduced the critical d/h ratio was soon reached. As the work progressed, it became clear that a huge flume would be needed to produce the points necessary to define the remainder of the curves.

As an alternative, a study of methods of computing the friction drag of the water on the bottom of a pulpwood jam was made. Results from laboratory tests and from some field tests on rafts of pulpwood towed at a uniform rate in deep water were now available. Analysis of these results showed that the force calculated from a form of the Karman-Prandtl equation for velocity distribution near rough boundaries could be used to indicate the friction drag with acceptable accuracy.

Extension of Analysis

The most convenient form of the Karman-Prandtl equation for this purpose is given below:

$$Fo = \frac{V_y{}^2 wL}{g[5.75 \log y/k + 8.5]^2} \quad \ldots . (V)$$

where

Fo is the friction force on the under side of the jam in pounds per foot of width.

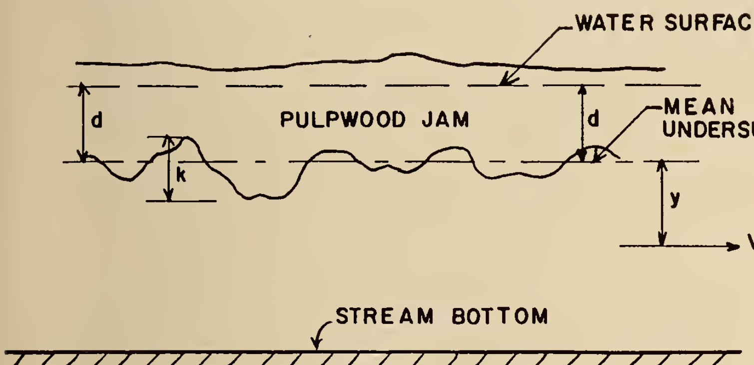


Fig. 10. Jam depth and roughness.

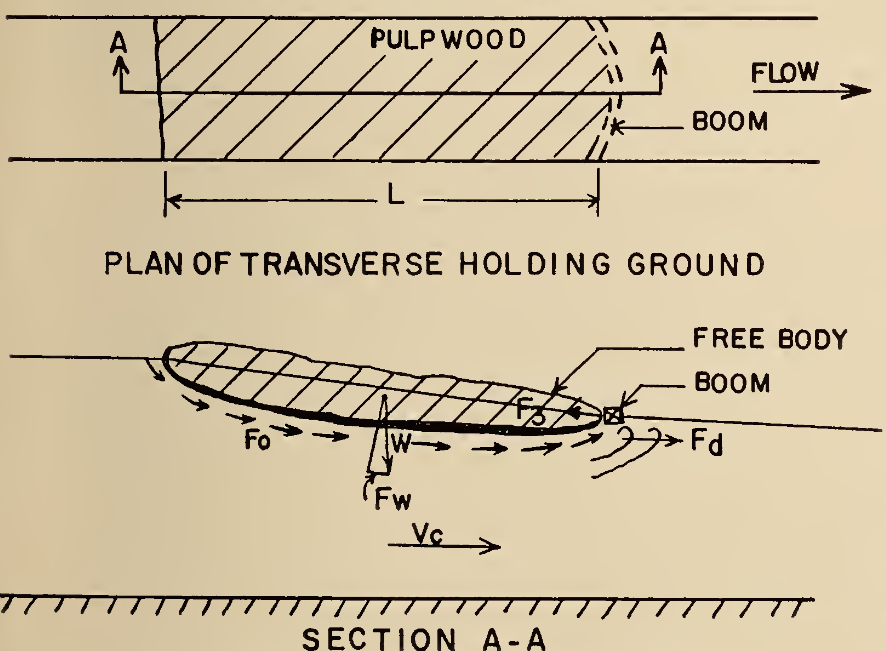
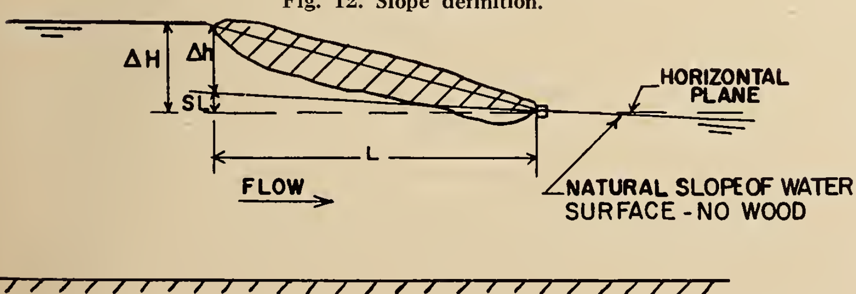


Fig. 11. Longitudinal cross-section with jam as free body.

Fig. 12. Slope definition.



V_y is the velocity at a distance y feet below the mean undersurface of the jam—feet per second.

w is the specific weight of water—pounds per cubic foot.

g is the acceleration due to gravity—feet per second per second.

L is the length of the jam—feet.

k is the absolute roughness of the under side of the jam—feet. (See Fig. 10.)

Measurements in both laboratory and field clearly showed that flow through a jam with obstruction ratio less than 0.4 was negligible.

Equation (V) and the information about flow through the jam made it possible to extend the original analysis and compute F_3. The change in the analysis is illustrated by Fig. 11, which is similar to Fig. 2 except that this time the jam only is taken as a free body.

In Fig. 11:

F_3 is the force on the boom in pounds per foot width.

F_d is the form drag of the body of the jam in pounds per foot width.

F_0 is the friction drag in pounds per foot width.

F_w is the component of the weight of the stationary mass which acts downstream because of the slope of the water surface, in pounds per foot width.

W is the weight of the mass of wood and water which is held motionless in pounds per foot width

$$F_3 = F_0 + F_w + F_d \quad \ldots . (VI)$$

This equation gives the value of the total downstream force since the shores are still assumed to be frictionless. The solution of two of the terms is particularly awkward. F_0, the friction on the underside of the jam, is computed from equation (V) and must usually be worked in steps like the standard step solution for a backwater curve. In addition, the probable velocity distribution in the water under the jam and the roughness of the underside of the jam must be estimated. F_w, the weight component, can be obtained only after Δh is determined by trial and error. Under these circumstances it was thought best to prepare curves from which the solution for given conditions could be read (Fig. 13). It was hoped that the d/h band for each Froude number would be narrow and that the roughness dimension k, which is to a great extent dependent on the depth of the jam, need not appear as an independent variable. Eventually it became clear that a considerable band of d/h values must be covered and that, consequently, the variation of k/h was significant. The points for Fig. 13 were computed with regular increments in the value of d/h and k/h, but the resulting plot was so complex that interpolation to find $\Delta h/h$ for a given set of conditions was very difficult. Finally, Professor F. M. Wood, of Queen's University, reworked the computed points of Fig. 13 into the nomographic form shown in Fig. 14. From this chart Δh may be obtained and substituted in equation (II) to calculate the downstream thrust for most conditions.

It should be noted that equation (VI) is complete in itself and may be solved for any given conditions. The Δh concept is retained and Fig. 14 presented only because the time required for the solution of most problems is thereby reduced from hours to minutes.

The Δh/h Curves

The method of calculating Δh follows

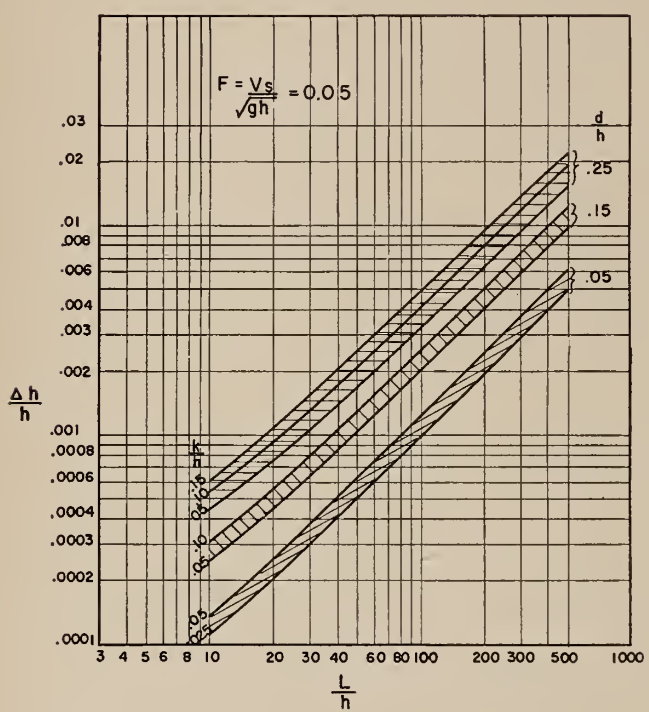


Fig. 13(a). Δh curves.

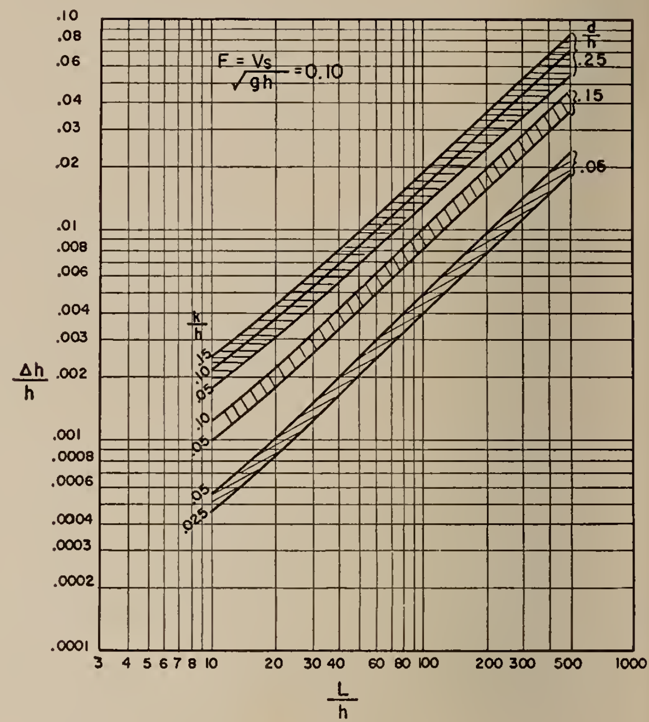


Fig. 13(b). Δh curves.

Fig. 13(c). Δh curves.

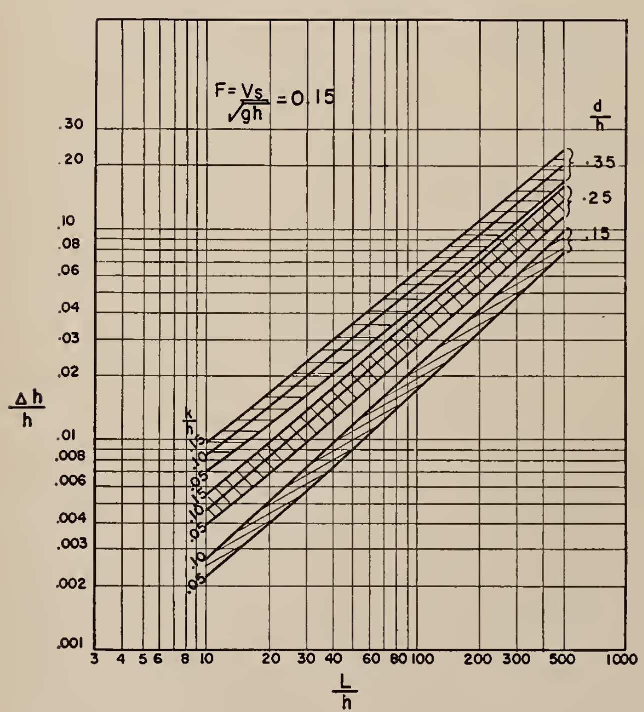
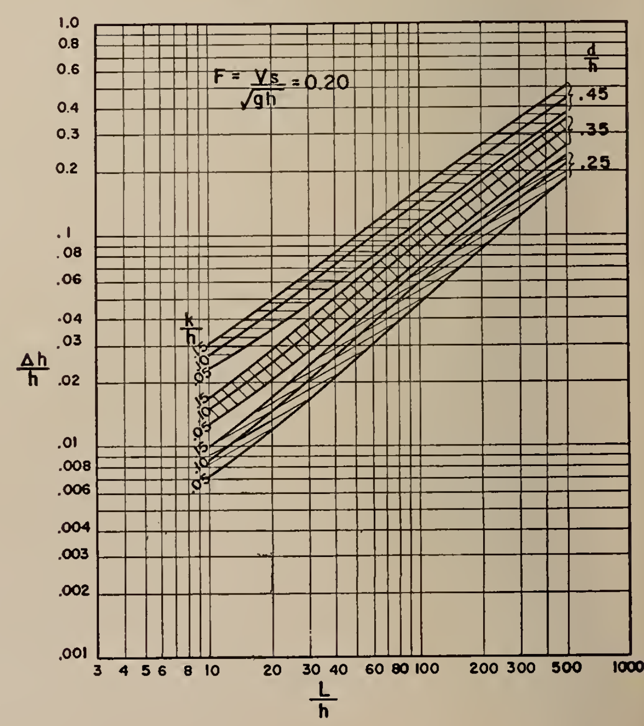


Fig. 13(d). Δh curves.



from equations (I), (V) and (VI).

$$F_3 = F_2 - F_1 - F_4$$
$$= F_0 + F_w + F_d \text{ (I) and (VI)}$$

$$F_2 - F_1 = \frac{w}{2}\left[(h_1 + \Delta h)^2 - h_1^2\right]$$

$$= \frac{w}{2}(2h_1 + \Delta h)\Delta h$$

Then

$$\frac{w}{2}(2h_1 + \Delta h)\Delta h$$
$$= F_0 + F_w + F_d + F_4,$$

and

$$\Delta h = \frac{F_0 + F_w + F_d + F_4}{\frac{w}{2}(2h_1 + \Delta h)} \quad \text{..(VII)}$$

Equation (VII) must be solved by trial and error to obtain Δh. The eventual goal is the determination of F_3, which may be calculated from equation (II) when Δh is known. If F_4, the momentum term, is arbitrarily dropped from equation (VII) and equation (II) it may be shown that the final value of F_3 is not affected except by a very small change in F_w which is induced by the slight change in Δh. This effect was found to be negligible and in the work which follows F_4 has been eliminated.

Equations (II) and (VII) now become:

$$F_3 = \frac{w}{2}(2h_1 + \Delta h)\Delta h \quad \text{....(II')}$$

$$\Delta h = \frac{F_0 + F_w + F_d}{\frac{w}{2}(2h_1 + \Delta h)} \quad \text{....(VII')}$$

To evaluate Δh for given conditions from equation (VII') we must first compute, F_0, F_w and F_d. F_0 is obtained from equation (V) using jam roughness indicated in Fig. 15 and a velocity distribution as measured between the bottom of the jam and stream beds where Manning's 'n' had a value close to 0.04. The proper choice of coefficients is difficult unless the operator has had some field experience.

F_w is obtained from the equation $F_w = W(\tan\theta)$, where $\tan\theta = \Delta H/L$ (Fig. 12) and $\Delta H = \Delta h + SL$. S is the natural slope of the water surface which can be found from Manning's equation:

$$S = \frac{V^2 n^2}{(1.49)^2 r^{4/3}}$$

r is the hydraulic radius of the stream.
n is Manning's 'n', assumed in these calculations to have a value of 0.04.

Because the unknown Δh appears in the expression for F_w, a trial and error solution is indicated. This would be very laborious for a single point, but the number of tries can be reduced to a minimum when working out continuous curves on a systematic basis. Using the previous points as a guide a value of Δh is assumed, the natural slope of the stream surface, S, is computed, and ΔH is equal to Δh plus SL. The natural velocity distribution in the vertical plane will be affected by the jam of wood and the SL term slightly increased, but this correction is small and has not been incorporated into this solution.

Since the flow of water through the jam is negligible, and d represents the mean depth of jam below the water surface, the weight of the motionless mass of wood and water is equal to the weight of the layer of water d feet deep by L feet long:

Thus, $F_w = 62.4(d)L(\Delta H/L)$
$= 62.4(d)\Delta H$

The form drag per foot width of stream is

$$F_d = C_d \frac{w}{g} d V_c^2$$

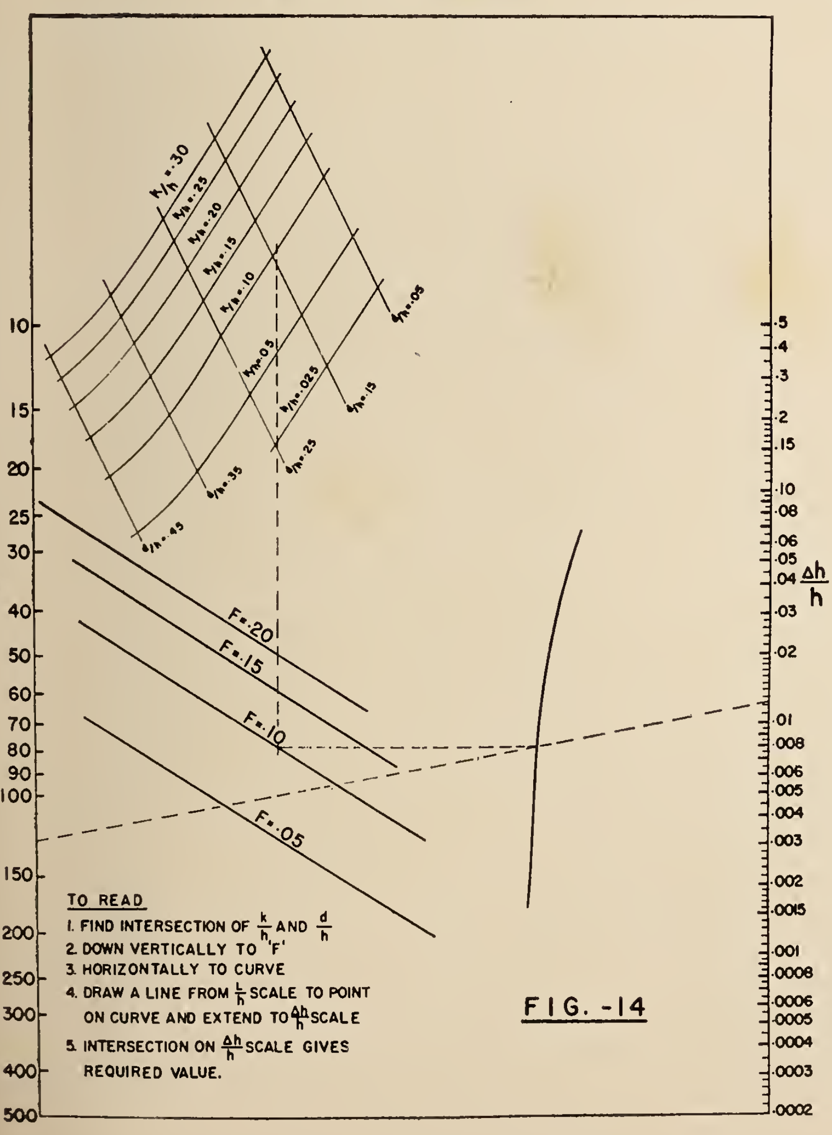
where

C_d is the coefficient of drag.
V_c is the average current velocity under the jam in the vicinity of the boom—feet per second.
d the depth of the jam in feet.

When the above figures have been obtained, Δh is calculated from equation (VII'). If it does not check with the assumed value, a new estimate is made and the solution repeated.

Figure 13 shows the Δh curves produced by plotting values obtained from this solution. These curves are of the type expected (see Fig. 3), but because the inclusion of the k/h lines made it difficult to interpolate and read the maximum value of $\Delta h/h$ for a given holding ground, the nomographic curves of Fig. 14 were developed. To use Fig. 14, the water velocity, depth of stream, length and depth of jam, and the roughness of the underside must be known. The probable depth may be obtained from Fig. 8, and Fig. 15 may be used as a guide in estimating the roughness.

Fig. 14. Δh/h nomograph.



Since the roughness, k, is the distance from the outside of the protuberances on the underside of the jam to the bottom of the openings between the logs (see Fig. 10), it cannot be measured accurately. Figure 15 was built up from field measurements and confirmed as far as possible by laboratory experiment and calculations.

Verification of the Δh/h Nomograph (Fig. 14)

The plan was to verify the $\Delta h/h$ curves by means of laboratory and field measurements. Since interpolation on the final version of Fig. 13 is difficult, a chart (Fig. 16) showing the correlation of $\Delta h/h$ as measured and as read from Fig. 14 was constructed. Considering the difficulty of measuring the variables concerned, the correlation is satisfactory.

When $\Delta h/h$ has been obtained, F_3, the force on the boom *for frictionless shores*, may be calculated from equation (II′). This is equal to the downstream thrust of the water on the wood, T_1, and is the solution to the first part of the problem.

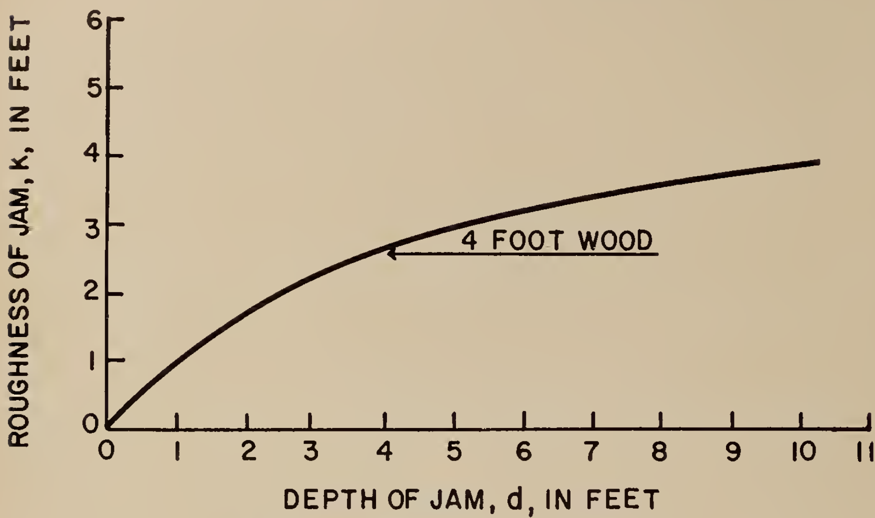
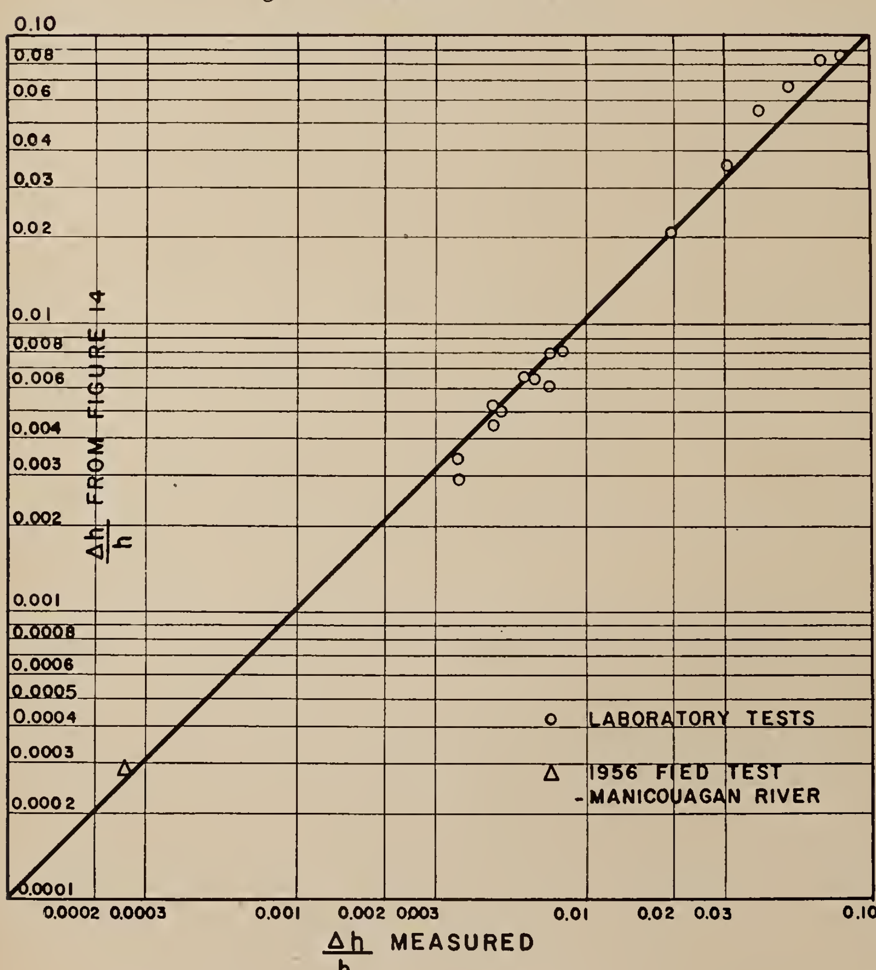


Fig. 15. Roughness of jam v. depth of jam.

Fig. 16. Correlation curve for Δh/h.



Shores Which Develop Friction

The downstream thrust, T_1, is not all transmitted to the boom system: much of it is absorbed directly by the shores. It was necessary to discover how much of this thrust is taken by the shores under given conditions. A mathematical solution based on the analogy between pulpwood in a river and granular material contained between two parallel walls was worked out. It was subsequently discovered that Janssen had developed the same solution in connection with the design of grain elevators.*

If in Fig. 17:

P is the force with which the jam upstream is pressing against the jam downstream in a direction parallel with the current in pounds per foot width of stream;

f_0 is the drag of the current on the undersurface of the jam—pounds per square foot:

k_0 is the coefficient of lateral thrust;

μ is the sliding coefficient of wood against wood;

Then

$$Pb - (P + dP)b + bf_0(dL) - 2\mu k_0 P(dL) = 0$$

and

$$-b(dP) + (bf_0 - 2\mu k_0 P)(dL) = 0$$

$$\frac{dP}{f_0 - 2\mu \dfrac{k_0 P}{b}} = dL$$

Solving

$$P = \frac{bf_0}{2\mu k_0}\left(1 - e^{-2\mu k_0 (L/b)}\right) \quad \text{..(VIII)}$$

First attempts to check equation (VIII) by model test were unsuccessful. Finally it became apparent that the ratio of the stream width, b, to the log length, l, (b/l), has a pronounced effect. When b/l is greater than 30, the jam seems to behave in accordance with equation (VIII). For lower values of b/l the percentage of force transmitted directly to the shores increases as b/l decreases.

A series of laboratory tests showed that the value of $2\mu k_0$ was approximately 0.4. Substituting this value in

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*The Design of Walls, Bins and Grain Elevators, M. S. Ketchum, McGraw-Hill, 1907.

equation (VIII) and dividing by f_0bL, the total downstream thrust in length L, gives the proportion of the total force transmitted to the boom.

The percentage of the total force on the boom is

$$\frac{100P}{f_0L} = \frac{100b}{0.4}\left[1 - e^{-0.4(L/b)}\right] \quad \text{.. (IX)}$$

This equation is plotted in Fig. 18. The points shown are from laboratory tests. No check could be made at higher values of L/b because L could not be increased and when b was decreased the b/l ratio dropped below 30 and the mass no longer behaved as granular material. Tests run at b/l values below 30 produced points which fell below the curve, and thus it is believed that the curve is a satisfactory basis for design. It may be shown that after the length of jam becomes equal to 6 times the width of river, 90% or more of the additional force is transmitted directly to the shores. Therefore, if a boom system can retain a jam of length equal to 6 times the width it is probably adequate for any longer jam.

Application of Results

The curves presented may be used to calculate the probable maximum load on a boom in a simple transverse holding ground on a straight stretch of river. The procedure is illustrated by the following example:

Consider a proposed holding ground where the depth of water, h, is 20 feet and the width of channel, b, is 400 feet. The maximum surface velocity, V_s, is 2.5 feet per second and the quantity of wood is such that the length of jam, L, is 2,500 feet. What will be the load on the boom system?

Assuming that in the worst case the wood will arrive when V_s is a maximum, then

(*a*) depth of jam will be 2.7 feet for V_s of 2.5 feet per second from Fig. 8.

The roughness, k, will be 2.2 feet from Fig. 15.

(*b*) The Froude number

$$F = V_s/\sqrt{gh} = 2.5/\sqrt{32(20)} = .099$$
$$L/h = 2500/20 = 125$$
$$d/h = 2.7/20 = 0.135$$
$$k/h = 2.2/20 = 0.11$$

For these values Fig. 14 gives

$$\Delta h/h = 0.0124$$

and then

$$\Delta h = 0.0124\ (20) = 0.248 \text{ feet.}$$

(*c*) The total downstream thrust

$$F_3 = \frac{w}{2}(h_1 + \Delta h)^2 - \frac{w}{2}h_1^2 \quad \text{..(II')}$$

$$= \frac{w}{2}\Delta h(2h_1 + \Delta h)$$

$$= \frac{62.4}{2}(0.248)(40 + .23)$$

$$= 312 \text{ pounds per foot width.}$$

(*d*) $$L/b = \frac{2500}{400} = 6.25.$$

Figure 18 shows that for this L/b ratio about 38 per cent of the total force is transmitted to the boom. The remaining 62 per cent is taken directly by the shores.

The probable maximum load on the boom system will be 0.38 (312) = 119 pounds per foot width of stream or a total load of 119 (400) = 47,600 pounds. The boom may be designed to withstand this force with a suitable factor of safety.

Continuation of Investigation

When this project was begun it was hoped that it would produce methods of calculating:

(*a*) The total force acting on a transverse holding ground.

(*b*) The division of this force among boom, piers and shores.

(*c*) The effect of wind on floating pulpwood.

(*d*) The forces on parallel holding grounds.

(*e*) The forces on tidal holding grounds.

The work done until Autumn 1954 has been detailed above. Since then studies of the division of force between piers and booms, and the effect of wind on floating pulpwood have been proceeding. Results of these continuing studies will be reported at a later date.

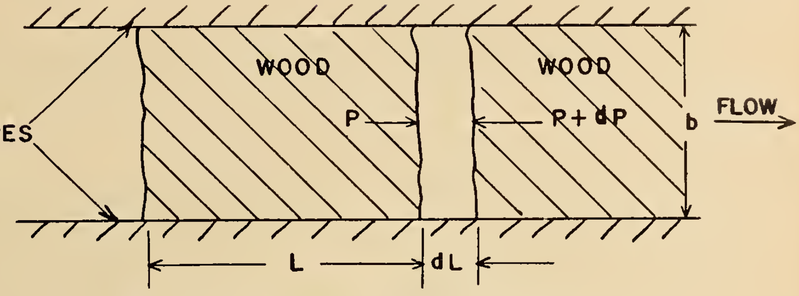


Fig. 17. Wood confined between parallel shores.

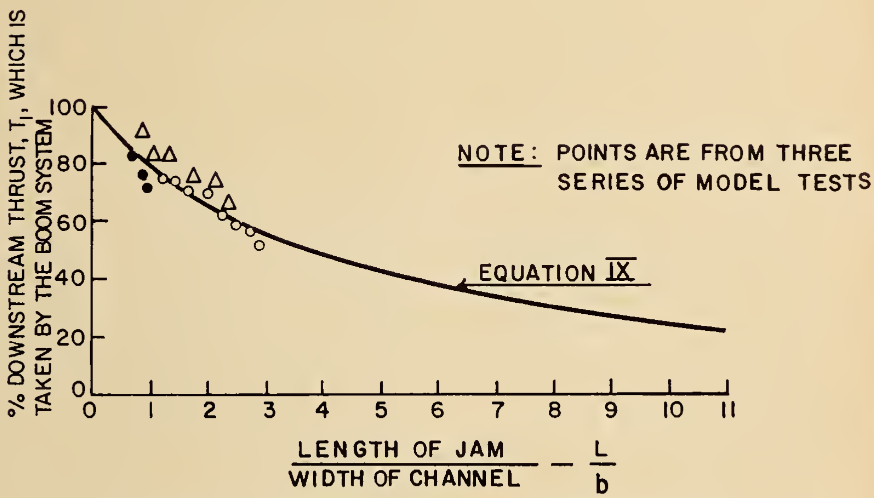


Fig. 18. Division of force between boom and shore.

APPENDIX I—LIST OF SYMBOLS

b	width of stream in feet.
C_1, C_2, C_3	assumed constants.
C_d	the coefficient of drag of an immersed body.
d	the mean depth of jam below the surface of the water in feet.
e	base of Napierian logarithm—2.718.
f	mathematical function.
f_0	friction of running water on underside of jam in pounds per sq. ft.
F	the Froude number $= \frac{V_s}{\sqrt{gh}}$
F_0	the force exerted by the friction of the water against the underside of jam in pounds per foot width of river.
F_1	the hydrostatic force at section 1 in pounds.

F_2 the hydrostatic force at section 2 in pounds.

F_3 the force necessary to hold the boom stationary in pounds.

F_4 the reaction to the force necessary to change the momentum of the water flowing under the jam in pounds.

F_w the component of the weight of the stationary mass of wood and water which acts downstream because of the slope of the water surface in pounds.

g the acceleration due to gravity—32 feet per second per second.

h the depth at the section indicated by subscript in feet.

Δh the differential head necessary to force water past the jam when the shores are assumed to be frictionless in feet.

ΔH $\Delta h + SL$ in feet.

k the absolute roughness of the bottom of the jam in feet.

k_0 the coefficient of lateral thrust—the ratio of the lateral thrust per foot length to the downstream thrust per foot width.

l the length of a pulpwood stick in feet.

L the length of the jam in feet.

P the force with which the jam is pushing downstream in pounds per foot width of river.

q discharge per unit width in cubic feet per second.

r the hydraulic radius of the river in feet.

S the slope of the water surface when no jam of wood is present.

V the mean velocity in feet per second at the section indicated by the subscript.

V_c the mean velocity under the jam.

V_m the mean velocity over a reach or length of river.

V_s the surface velocity.

V_y the velocity at a point y feet from the boundary.

w the weight of water in pounds per cubic foot.

W the weight of the stationary mass of wood and water in pounds per foot width of river.

μ the sliding coefficient of wood against wood.

θ the angle subtended by mean water surface and the horizontal.

y the distance in feet from the mean undersurface of jam to a point at which the velocity is V_y.

APPENDIX II—1956 FIELD CHECK ON METHOD OF CALCULATING FORCES ON PULPWOOD HOLDING GROUNDS

On June 8th measurements taken between 8 a.m. and 11 a.m. indicated that the forces noted below were acting on the Manicouagan holding ground of the Quebec North Shore Paper Company.

Pier No. 7
East cable—3580 pounds
West cable—3000 pounds.
Bulkhead—3060 pounds.

Pier No. 8
East cable—3000 pounds
West cable—2560 pounds
Bulkhead—1950 pounds

Pier No. 7 was resisting a total force of 9640 pounds and Pier No. 8 a force of 7510 pounds. Forces on the individual bulkheads changed considerably during the test, while the sum of the two changed through a smaller range.

The piers are 200 feet apart and the center line of the row of piers makes an angle of about 60° with the direction of the current. Thus, two piers support about 400 cos 30°, or a 350 foot width of jam measured in a direction at right angles to the current. The total thrust of this width of jam was 9640 + 7510, or 17,150 pounds. The average thrust per foot width was 17,150/350, or 49 pounds.

The holding ground contained about 45,000 cords of wood jammed two feet deep for 1500 feet upstream of Piers 7 and 8. The river discharge was 150,000 cubic feet per second and a 12 m.p.h. wind was blowing almost directly downstream. The current velocity at a depth of 10 feet was 1.4 feet per second and the average velocity about 1.6 feet per second.

Calculation of Force using Δh/h Curves

The Manicouagan holding ground is very wide—about 3000 feet at the boom. It was assumed that none of the thrust originating towards the centre of the river would be transferred to the shores by the action of the jam itself.

The 12 miles per hour wind flowing over a jam of the roughness measured was calculated to cause a downstream thrust of 8.3 pounds per foot width (this development is not covered in the present article). The remaining measured force, 49 pounds less 8.3 pounds, or 40.7 pounds per foot width, may be attributed to the thrust of the water.

Available data:

V_m = 1.6 feet per second
h = 50 feet
d = 2 feet
L = 1500 feet

If the wood had not been there the surface velocity V_s would have been, by calculation, 1.85 feet per second. If the wood had arrived in the holding ground with this current the jam would have been more than 2 feet deep. It actually had arrived in slack water and the consolidated jam measured slightly less than 2 feet deep. The roughness, k, was 1.75 feet.

$$F = \frac{1.85}{\sqrt{32(50)}} = 0.046$$

$$k/h = \frac{1.75}{50} = 0.035$$

$$d/h = \frac{2.0}{50} = 0.04$$

$$L/h = \frac{1500}{50} = 30$$

From Fig. 14, $\Delta h/h$ is found to be .00028

$$\Delta h = h(.00028) = 50(.00028)$$

$$= 0.014 \text{ feet}$$

$$F_3 = \frac{w}{2}(\Delta h)(2h_1 + \Delta h)$$

$$= 31.2\ (.014)\ 100.014$$

$$= 43.6 \text{ pounds per foot.}$$

This compares closely with the measured thrust of 40.7 pounds per foot.

Future Annual Meetings

1958

Quebec, Chateau Frontenac, May 21, 22, 23

1959

Toronto, Royal York Hotel, June 8, 9, 10

Air Pollution Control at A Nylon Intermediates Plant

H. R. L. Streight

Principle Chemical Engineer, Du Pont Company of Canada (1956) Limited

Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June, 1957

An extensive pollution control program was started during the design of the organic chemical plant, built in an agricultural and recreational community at Maitland, Ontario. Air pollution was reduced by designing the boiler house stacks for adequate dispersion of flue gases and by developing and installing an absorption system for almost complete removal of oxides of nitrogen in effluent gases. Atmospheric surveys, made before and after operation began, showed the low and safe concentrations of potential contaminants.

MODERN scientific methods have been employed to control within acceptable limits atmospheric and aqueous pollution from a plant, designed and operated by Du Pont of Canada, for the manufacture of nylon intermediates, the basic chemicals for making nylon. The Company is anxious to prevent or minimize pollution that may result from the operation of the new organic chemical plant.

The location of the plant is shown in Figure 1.

The 1500 acre site is on the St. Lawrence River, 7.3 miles northeast of Brockville (12,000 population), 4.5 miles southwest of Prescott (3,500 population), and 3.8 miles from Ogdensburg, N.Y. The Montreal — Toronto highway crosses the property near the river and the Canadian National Railways line divides the property about two thirds of a mile behind the highway. In topography, the land rises gently from the river and is essentially flat or slightly rolling. The surrounding area has a number of cottages and motels alongside the river, with orchards on the sides and bushland north of the railway. Recreational activities include boating, sailing, and fishing.

The processes used for the production of nylon intermediates are based on complex organic reactions and are large consumers of steam and other services. In the manufacture of the raw material, nitric acid, and the intermediates considerable quantities of solid and liquid by-products and off-gases are formed and this necessitates careful planning and treatment to effect safe and economic means of disposal acceptable to the community. The main by-products are essentially fly ash from the boiler house and organic liquors and tars which were to be burnt in an open incinerator; the off-gases contained oxides of nitrogen from several process buildings and sulphur dioxide from the boiler house.

The policy adopted was to design and operate the plant so that the quantity and concentration of any contaminant would not approach a level which might cause a nuisance or damage to persons, property or vegetation in the community.

Successful control measures cannot be instituted without a comprehensive knowledge of the amounts of pollutants emitted from all major sources in relation to the concentrations found in the air. Three general methods are available for determining the effectiveness of diffusion in dispersing gaseous and particulate contaminant.

(1) Calculate the rate of dispersion and maximum ground concentration.

(2) Make an atmospheric survey.

(3) Test dispersion in a wind tunnel, using a model of the building releasing an effluent gas.

The programme by which this policy was put into effect at Maitland comprised the following steps:

(1) Design features.

(2) Atmospheric surveys.

(3) Garden plots.

(4) Development of a method for reducing the concentration of a contaminant.

The number and height of the stacks on the boiler house were based on the calculated rate of dispersion of sulphur dioxide and particulate matter. The two atmospheric surveys, made before and after the plant operated, gave useful information on the concentrations of potential pollutants, any subsequent increases from the nylon intermediates plant and boiler house, and ground concentrations of contaminants which could be compared with the values calculated for dispersion from the stacks of the boiler house. Early signs of damage could be obtained from an inspection of garden plots planted with sensitive flowers and vegetables which are more readily affected by fumes than individuals. The toxic concentration of a pollutant from the incinerator used to burn organic wastes would be shown by the plants in a nearby garden plot and by apples on the trees, 200 to 300 feet away. A study showed that the oxides of nitrogen leaving the nitric acid and nylon intermediates plants could be reduced by absorption in an alkaline solution. The results of pilot-plant tests were successfully applied in the design and operation of a large fume absorption system. The efficiency of operation was so improved in the field that the treated off-gases left in an almost colourless condition. During operation, source - control methods included good combustion, proper maintenance, and good housekeeping.

The proposed methods of treating off-gases and by-product waste streams were discussed with consultants who have a wide knowledge of air pollution. During the design, Dr. Morris Katz, an international authority on air pollution, was retained as a consultant to advise on the dispersion of the combustion products and the design of the boiler house stacks. The Ontario Research Foundation undertook the comprehensive atmospheric surveys which extended over a period of 25 months. Dr. Katz furnished the list of flowers and vegetables to be planted in the garden plots and subsequently examined their condition as well as that of apple trees within the property.

The experience gained in each air pollution problem has convinced us that air pollution from a complex organic chemical plant can be controlled.

Threshold Limits

For every chemical contaminant there is a threshold limit or maximum ground concentration that acts as a guide in the control of health hazards to persons and of damage to vegetation. The threshold limit varies widely for each compound and should be regarded as a line between safe and dangerous concentrations. In many cases, reliable information is still lacking and authoritative opinion is conflicting.

For Persons. The threshold limits shown in Table I represent average concentrations of substances in the air to which workers may be repeatedly exposed for a continuous number of days without having their health adversely affected.[1] A selection has been made of gases and vapours encountered in the manufacture of nylon intermediates or produced in a boiler house.

Table I.—Threshold and Fatal Concentrations for Persons

		Max. Conc. p.p.m.	Fatal Conc. p.p.m.
Ammonia	raw material	100	2,500
Carbon dioxide	ex boiler house	5,000	
Carbon monoxide	ex boiler house	100	2,000
Cyclohexane	raw material	400	
Cyclohexanol	int. product	100	
Cyclohexanone	int. product	100	
Nitrogen dioxide	waste gas	5*	100–150
Sulphur dioxide	waste gas	10	50–250

* 10 parts per million are permissible for 8 hours/day, 5 days/week[2]

For Animals and Insects. The effect of pollutants on animals and insects is much less than on plants. For instance, air contaminants which damaged alfalfa by 25 per cent did not affect the cattle consuming it.[3]

For Vegetation. There are many sources of information on threshold limits for flowering and crop plants, fruit and conifer trees; references should be consulted to determine the influence of a number of variables which alter the fumigation limit for a specific plant i.e. age, environment and duration. The effects of potential Maitland pollutants, sulphur dioxide (SO_2), oxides of nitrogen and ammonia, on vegetation are described.

(a) Sulphur dioxide. Usually SO_2 is given first consideration as it is present in a greater amount than other air pollutants. Acute injury to vegetation usually presents a typical and easily recognized pattern of collapsed areas in leaves and is caused by the entrance of SO_2 through any open stomata of the leaves. Most plants close their stomata at night, although those of alfalfa, potato and certain other plants remain open. Environment which opens the stomata can favour injury by SO_2; this includes a temperature above 5 deg. C., adequate supply of moisture to the roots, a high light intensity and a high relative humidity [4-6]. For instance, the relative resistance to injury increases tenfold as the relattive humidity decreases from 100 to 0 per cent.[7]

Plant species vary in their susceptibility when exposed to known concentrations of SO_2. Alfalfa is among a list of the most sensitive plants and is marked by 0.4 p.p.m. after 7 hours exposure. Exhaustive tests have been made on more than 300 species and varieties of plants under controlled conditions of fumigation and the results expressed on a basis of alfalfa or barley, taken as 1.0 p.p.m. SO_2 at 100 per cent relative humidity.[5] The ratings of susceptibility of the plants used in our garden tests and of surrounding trees are in Table 11.[7]

Table II.—SO_2 Threshold Limits for Vegetation

Plant	Form as Planted	Basis (Alfalfa = 1.0)
Dahlia	bulb	1.5–2.0
Carrot	seed	1.5
Lettuce	seed	1.2
Cosmos	plant	1.1
Petunia	plant	1.0–1.2
Zinnia	plant	1.0–1.2
Gladiolus	bulb	2.6
Tomato	plant	1.3–1.7
Daffodil	bulb	—
Tree		
Apple		1.8
Maple		3.3
Plum		2.5
Pine		7.5–15

In general, SO_2 may be toxic to sensitive plants at a concentration greater than 0.4 p.p.m. during the growing season when the conditions for rapid absorption are at a maximum during a long period of exposure. Low concentrations of SO_2, 0.20 p.p.m. or less, have no influence on plant life as shown in a detailed study on crop plants and conifers.[4] Plants have a marked ability to recover from the effects of SO_2.

(b) Oxides of Nitrogen. Injury to vegetation near large nitric acid plants has been noticed. Brown margins, brown to black spots on the leaves and a bright yellow tint on the needle tips of conifers indicate the damage caused by concentrations of 25 p.p.m. of nitrogen dioxide.[7]

(c) NH_3. Ammonia is a gas of intermediate toxicity and will brown the leaves of plants. The threshold limit of sensitive plants (sunflower, tomato, etc.) has been given as 8 p.p.m. over a 5 hour period, 17

p.p.m. over a 4 hour period and up to 40 p.p.m. over a 1 hour period.[6]

Accepted Threshold Limits

The permissible ground concentration of any pollutant should not affect the health of individuals or damage the growth and appearance of neighboring vegetation. As the threshold limits are not in complete accord, the values in Table III provided by our consultants were accepted for pollution control at Maitland Works.

Stacks for Boiler House

The volume of gases leaving the boiler house is large as the chemical plant has an annual coal consumption of 60,000 tons/year. With the prevailing SW wind and under conditions of temperature inversion, the maximum concentration of SO_2 may occur at a distance beyond the eastern boundary of the property, 6,600 feet from the boiler house. Likewise the emission of dust and fly ash is important as the coal contains 8-10 per cent ash.

Recent advances have made it possible to design boiler installations which will give emissions that do not constitute a nuisance. The combustion of coal releases SO_2, finely divided particulates, and a dustfall of soot and fly ash. Dispersion from a stack depends on many factors which were considered during design. In a light wind, the plume from a stack will gradually rise and flow downwind until dispersion is complete while in a strong wind, gust or unstable atmosphere such as vertical convection, the flue gas will be brought to the ground before the gases have completely dispersed. During a period of calm, temperature inversion or if the stack is not sufficiently above the level of a nearby building, the exit gases can reach the ground in high concentrations. In all cases, level ground is assumed for steady and uniform dispersion.

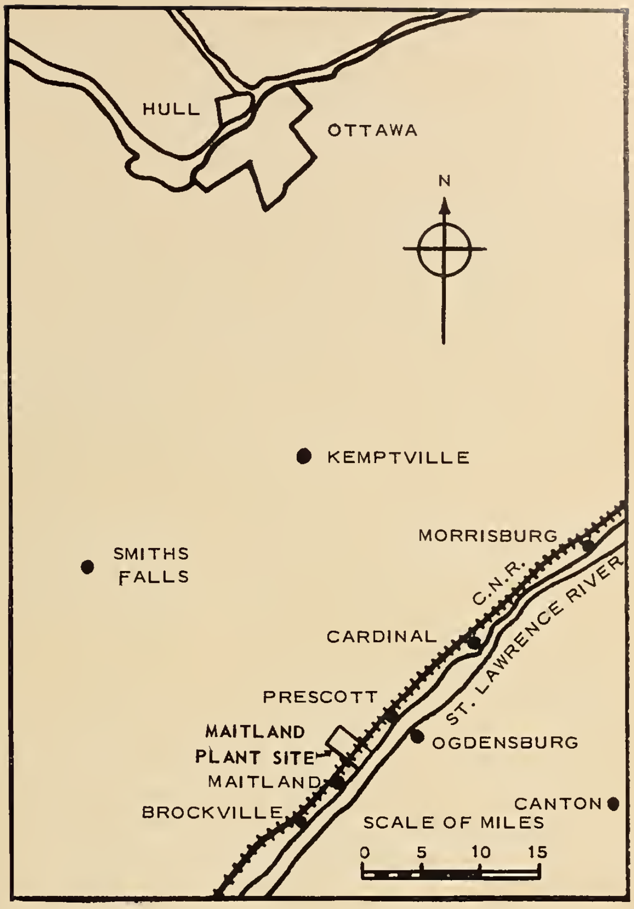


Fig. 1. Location of Maitland plant.

The most useful relationships for predicting atmospheric diffusion are those of Bosanquet et al.[8, 9] and of Sutton.[10] The formulas contain turbulence parameters or eddy-diffusion coefficients that are functions of atmospheric stability and turbulence. The actual stack height is increased to an "effective stack height" which is the sum of the stack height, the rise caused by the velocity of the stack gases and the rise attributable to the density difference between the stack gases and the atmosphere. The effective height should be sufficient to stop downwash in the vicinity of the stack.

The design of the Maitland stacks the addition of 29 per cent excess air was based on the coal consumption, the 1.5 to 3 per cent sulphur and 8 to 10 per cent ash contents of the coal, and release of 90 per cent of the sulphur in the ash to the atmosphere as SO_2. As at least 85 per cent of the ash was to be removed from the flue gas by dust collectors, it was estimated that the ash emitted to the atmosphere would be 110 lb./hr. per boiler of which 70 lb./hr. would be greater than 10 microns in size. Using Sutton's formula, calculations were made on the dispersion of SO_2 from 1 and 3 stacks and for low and high concentrations of sulphur in the coal.

To effect the desired reduction in the pollution level, one of two alternatives could be adopted: a single 250-ft. high stack or the selected three 125-ft. stacks, i.e. one per boiler. The maximum SO_2 ground concentrations shown in Table IV were calculated for burning 8440 lb./hr. of

Table III.—Accepted Threshold Limits

Contaminant	Permissible Ground Concentration p.p.m.	Critical Ground Concentration p.p.m.	Duration of Exposure
Sulphur dioxide	1.0	1.0	1 hour
	0.5	—	up to 8 hr./day
	0.25	0.3	prolonged
Nitrogen dioxide	—	10	up to 8 hr./day
Ammonia	—	8	up to 5 hr.

Table IV.—Maximum SO_2 Ground Concentrations from Stacks

Wind Velocity miles/hour	Meteorological Condition	Effective Height ft.	Sutton max. conc. SO_2 p.p.m.
2.2	strong inversion	988	0.036
4.4	strong inversion	487	0.075
6.6	mild inversion	318	0.117
11.0	isothermal	198	0.181
15.4	adiabatic	154	0.214

coal containing 1.75 per cent sulphur and dispersion of flue gases from a 125-ft. high, 6-ft. diameter stack per boiler. Emission from the boiler plant is treated as a continuous point source.

There should be no damage to vegetation as the maximum SO_2 concentration is below 0.3 p.p.m., the value accepted for the growing season. The sulphur content of the coal could be increased to 3.0 per cent during the non-growing season with the maximum SO_2 concentration remaining below the level of 0.5 p.p.m.

If the three stacks are discharging at the same time, the distance from the points of emission at which the three plumes unite downwind was estimated to be not less than about 500 feet, the stacks being 38-ft. apart. This distance would increase under temperature inversion or conditions of low turbulence as the plumes would rise to a greater height above the stacks. Again if the plumes of the three stacks were to join and form a continuous line source, the gas would not disperse as rapidly and the maximum SO_2 ground concentrations would be higher and vary from 0.5 to 1.1 p.p.m. except under certain meteorological conditions when the three plumes would rise and join farther from the source. The dustfall would also increase. The rate of dispersion of suspended particulate matter and dustfalls (light and heavy particles respectively) from the stacks were estimated to be low, 0.15 to 0.53 milligrams/cubic metre and 1 to 2.7 tons/(square mile) (month) and would not be a nuisance.

Comparison of Empirical and Field Concentrations

The verification of the theoretical diffusion formulas by field tests is of great interest to consultants on air contamination. Only a few correlations between calculated and actual ground concentrations have been reported, largely because of the difficulties encountered. For instance a large number of analyses for SO_2 have to be made at various distances from the stack and detailed meteorological information is required on wind, temperature, rainfall, etc. For tall smelter stacks, agreement was only found between Sutton's calculated SO_2 ground level concentrations and field tests provided the value of the turbulence parameter was reduced from 0.3 to 0[11]. For an 80-ft. stack, average concentrations for 30-min. or longer were about half the values predicted by Bosanquet and by Sutton.[12] The Sutton values were much higher near the stack.

The 12-month atmospheric survey made after the nylon intermediates plant commenced operation adds further knowledge on the accuracy of predicting maximum ground concentrations. The maximum average SO_2 concentrations recorded during the winter lie below the range calculated for continuous point and line sources. According to field tests, the SO_2 never exceeded 0.20 p.p.m. for an hour or more although peak values up to 0.32 p.p.m. were found during shorter periods of time and lower values (average 0.06 p.p.m.) were found over a 5-hour period. A comparison of calculated values and field results indicate that the former are approximately twice the actual values found in the survey.

Likewise the calculated values of suspended particulates or dust concentrations to be expected under varying meteorological conditions indicated maximum values of 0.15 to 0.53 mg./cu.m. The maximum concentrations found by analyses, 0.090 and 0.119 mg./cu.m. were below the calculated values. A comparison of empirical and field values indicated that the former can be approximately three time the latter.

How does the SO_2 level vary with distance from the source? Based on Bosanquet's equation[8] the SO_2 ground level concentration may be predicted at distances downwind from any stack both for low, average and high turbulence. It is of considerable interest to compare the calculated values with those found in the atmospheric survey. Accordingly the SO_2 ground concentrations were estimated for average turbulence and distances up to 4500-ft. away from the stacks of the boiler house and shown as a curve in Fig. 2. The averages of numerous SO_2 analyses determined during downwind conditions are marked as points on this figure. As each sample was collected over a period of time and under varying meteorological conditions, the analyses are best compared with the values for average turbulence.

The measured SO_2 ground concentration, at a distance downwind from the stack, was found to be about one half to two thirds of the calculated value except near the peak concentration shown in Fig. 2.

Atmospheric Surveys

The ground level concentration of contaminants is now recognized as a controlling factor in appraising the potential contamination of the atmosphere by a new plant. In an atmospheric survey it is usual to measure the ground concentrations of SO_2, suspended particulate matter (dust) and deposited matter (dustfall) arising from the steam plant; organic aerosols from combustion might be increased by losses of organic materials from the process buildings. To avoid nuisance or damage, no contaminants should exceed a threshold limit. Sulphur dioxide is usually given first consideration as it is present in a greater amount than any other contaminant and a small amount can be quickly determined by simple and well-developed methods. A valuable index of pollution is the concentration of suspended matter i.e. small particles of complex composition which are not more than 10 microns in size. Aerosol contaminants give another guide to pollution as all combustion processes produce small liquid and solid particulates 0.1 to 10 microns in size; the size range of tobacco smoke, ammonium chloride and fog are approximately 0.01-0.15, 0.1-2 and 1-40 microns in diameter.[7] Dustfall is a valuable indication of the amount of fly ash and consists of particles larger than 20 to 40 microns which settle readily and can be collected and measured in dustfall containers. Dustfall is two to three times as great in the winter as the summer,

Table V.—Dustfall in Various Locations

Area	tons/(square mile) (month) Variation [20]	Av. [21]
Heavy to medium	65–100	92
Medium or moderate	50–65	54
Low	35–50	40
Residential (Canada)	11–30	20
Rural (Canada)	3–11	—
Ocean	0.35	—

Table VI.—Comparison of SO_2 Concentrations (parts per billion)

Winter Values	Maitland				McGregor	Leicester (30 mi. away)
Wind Direction	NE	SE	SW	NW		
SO_2	3	0.1	5	1	6.1	3

owing to additional heating, and varies on location as in Table V.

An atmospheric survey was made before the plant commenced operation to determine whether the air in this area conformed to "clean country air" or was more polluted and could be classified as "suburban air". It was possible that air contaminants came from the C.N.R. locomotives and the ships in the St. Lawrence River which are nearer than the two neighboring centres of population, Brockville and Prescott-Ogdensburg. Brockville has a round-house in the railway yards and a number of medium-sized industries, Prescott has fewer industries and Ogdensburg has a paper mill. The nature, distribution and dispersion of contaminants in an urban area has been reviewed by Dr. Katz.[14]

The first survey, October 1952 to May 1953, was called the "blank run" as the values could be compared with others found in the second survey, October 1953 to October 1954, named the "operating period", conducted a few months after the plant started. The surveys established the contaminant levels and determined if the operation of the nylon intermediates plant added to the pollutants which were found and recorded in a new area.

A large number of tests must be made to obtain reliable average readings as the following meteorological conditions can affect the results.

(1) Inversion over a smoke plume —an upper stable area prevents movement of the air below and smoke will rapidly descend.

(2) Sudden increase of turbulence near the ground — the smoke will drift downwards and reach the ground in maximum concentration under the plume. This generally occurs about one half hour after sunrise in the summer.

(3) Velocity of wind — a high speed improves dispersion and reduces the ground level concentration.

(4) Direction of wind — the degree of pollution will vary with changes in the direction of the wind, an occurence that may take place slowly or quickly.

(5) Temperature of atmosphere —a large temperature differential in the air and above the ground level will reduce pollution. This occurs often in the winter. The movement of a cold front and passage of cold air into a warm region will act in this manner and reduce pollution.

(6) Precipitation — rain, snow and hail will reduce a pollution level.

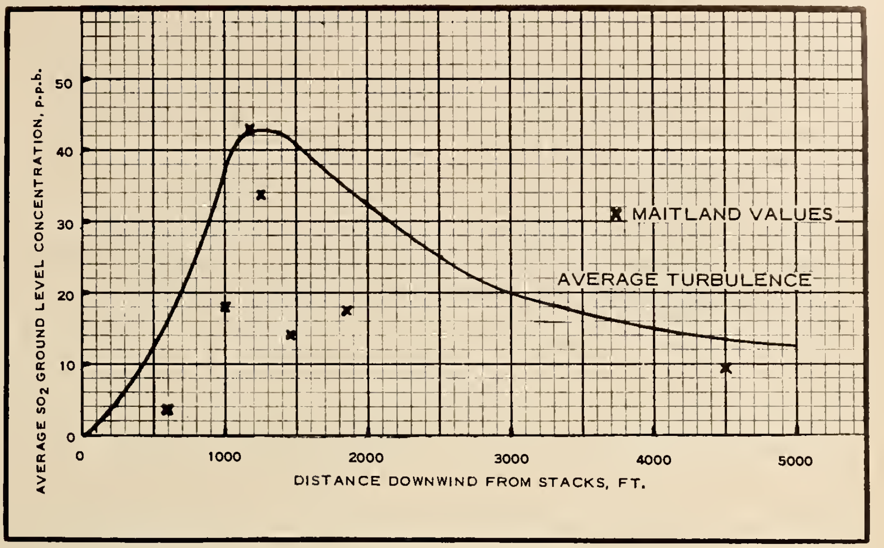


Fig. 2. Variation of average SO_2 ground concentration with distance from stacks.

Accordingly an analysis of meteorological information is necessary as a background for an intelligent interpretation of the results of an atmospheric survey. Temperature, barometric pressure, humidity, hours of sunshine, inches of rain, and wind speed and direction were recorded. The distribution of the wind, blowing in each direction of the compass is normally shown as a wind rose which is very useful in locating the source of a contaminant. The 1954 wind rose at Maitland is given in Fig. 3 and the wind velocities in Fig. 4.

At Maitland the prevailing wind direction is SW and the highest recorded wind speed is 73 miles hour.

The SO_2 measurements were made with a Thomas autometer, suspended particulates (commonly called dust) and organic aerosols were collected in dust and aerosol samplers; the dust was trapped on filter paper and the organic aerosols on silica gel. Four dustfall collectors of the Detroit type, as shown in Fig. 5, were used throughout the investigation.

The collectors are a development of the Harvard wind-tunnel experiments and have been used in the Detroit-Windsor Pollution Survey by the International Joint Commission. The dustfall varies according to the type of collector (Detroit, Toronto, Pittsburgh, and British Standard); a Toronto value should be multiplied by 1.82 to equal the Detroit value.[20] McKinnon Industries Ltd., St. Catharines, Ont., kindly lent a testing station, the dust samplers and autometer. In the second survey, the McKinnon station was used as well as a new mobile testing laboratory which was moved as a trailer from one location to another.

The meteorological factors were determined by the following standard instruments:

Casella sunshine recorder, rainfall recorder and barograph.

Bendix-Friex hygrothermograph for temperature and humidity, aerovane and recorders for wind speed and direction.

All instruments were calibrated before and after a survey.

The locations of the dust cans, McKinnon stationary testing station and garden plots are shown in Fig. 6. They were placed 1200 to 3200 feet from the boiler house stacks.

1. Blank Run

(a) SO_2. To assess the degree of pollution around Maitland, the determined mean concentrations were compared with values reported for rural areas, at McGregor which is 15 miles south of Windsor, Ont.[15] and at a location 30 miles from the city of Leicester, England.[16] Figures are in Table VI.

The average SO_2 concentration is similar to clean suburban air, found 10 to 20 miles from a large city.

The pollution pattern shows the effects of Brockville and Ogdensburg as well as indicating low but important pollution from an unknown NW source, perhaps from Ottawa and Hull which are 50 miles from the plant.

An examination of the SO_2 analyses showed a standard diurnal variation i.e. well defined peak concentrations at 10—noon and in the late evening, the actual time depending on the month. There is a monthly variation in SO_2, the mean concentration increasing from 2.4 to 5 p.p.b. between October and February and decreasing to 0.5 p.p.b. in May.

(b) Aerosols. The mean concentrations of suspended particulates (dust) are comparable to those reported at McGregor[15] and higher than reported near Leicester,[16] the value recorded for a residential area in Cincinnati is also higher[17] (Table VII).

The Maitland concentrations are higher than normal for a rural area, the highest level coming from the NE, Ogdensburg. The concentration was similar during an 8, 16, 24, or 32 hour collection period, with a monthly maximum in November and minimum in February.

The concentration of organic aerosols is usually of the same order of magnitude as the suspended solids and as the mean is only 56 per cent of the suspended matter, the latter must arise more from a mechanical source than from combustion which is the usual source of aerosols.

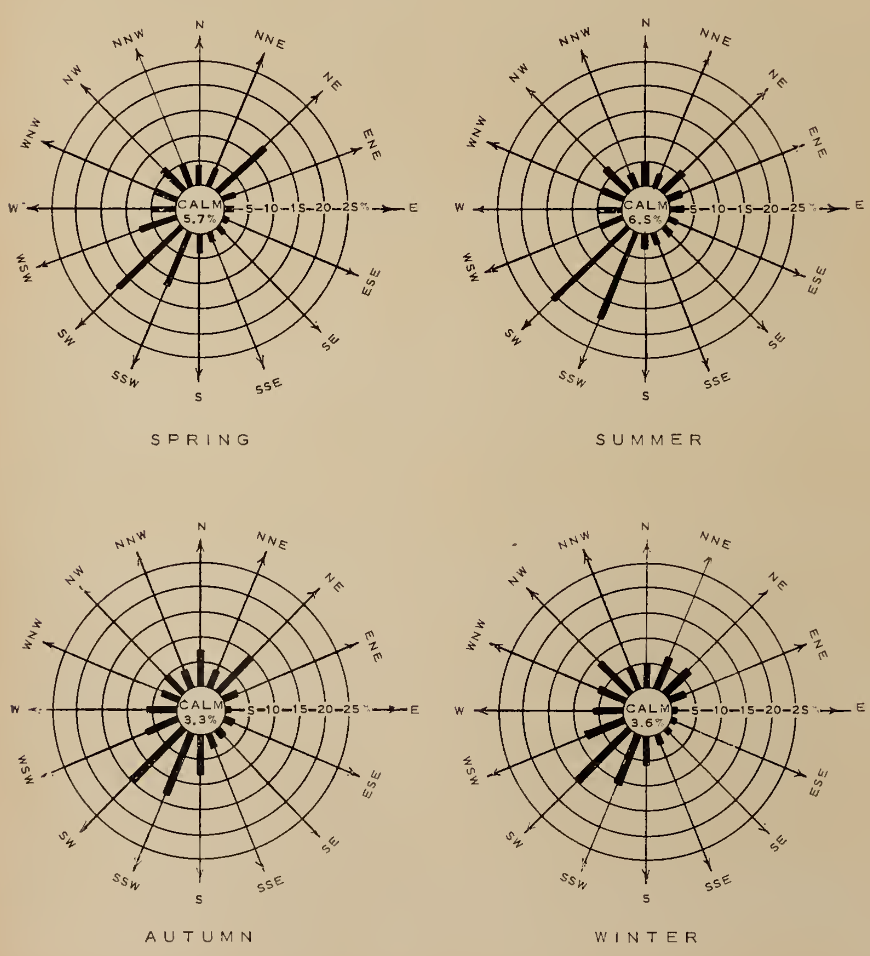
(c) Dustfall. The dustfall at Maitland is similar in value to that found near Toronto[18] and is lower than recorded in the city of Toronto[18] and in a semi-rural area near Windsor.[14] (Table VIII).

2. *Operating Period*

(a) SO_2. The maximum pollution caused by SO_2 occurred with winds clearly showing the boiler house stacks as a source; all concentrations were below the threshold limit. As in the blank run, the occurrence of SO_2 pollution was noticed with NE winds.

The monthly variation of SO_2 differed in the blank and operating periods, possibly caused by heavy snowstorms or other meteorological conditions. The daily diurnal variations in SO_2 concentrations are shown in Fig. 7; values given for Leicester, Los Angeles, and St. Louis are plotted on this figure as the maximum concentration was said to depend on location.[7] The Maitland values are comparable with Leicester and Los Angeles.

Fig. 3. Wind rose at Maitland works, 1954.



A number of tests were made in the mobile trailer, up to 4,400-ft. NE of the plant. The average concentration of SO_2 in SW winds, downwind from the plant, was reduced by 1/2 to 2/3 of the value at 1200-ft. This information indicates the degree of dispersion in a distance equivalent to 35 actual stack heights. The SO_2 frequency and average concentration were similar at various locations on the plant-site, the highest values coming from winds passing over the boiler house.

(b) Aerosols. The average dust concentration, through the winter months shows a decline from November to a low in January and February followed by a steady rise until May. The mean dust concentration is similar for the blank and operating periods. (Table IX).

The organic aerosol concentrations were satisfactory although in March the values were high, exceeding 0.15 mg./cu.m. This corresponded to a period when operating conditions at the incinerator were particularly bad, the fumes from the incinerator being carried towards the sampling point. Better control of the incinerator was achieved late in March and the organic aerosol levels returned to normal. The average concentration in the summer did not differ from values taken during a plant shut-down, namely 0.05 mg./cu.m. It appears that in the summer months the contribution of the plant to suspended particulate matter is relatively slight.

(c) Dustfall. Comparable pickups were obtained from the four dust collectors. A comparison of compositions obtained in the blank run and in the operating period is shown in Table X.

The water-soluble dustfall was considerably higher in the operating period, possibly owing to a large fall of snow — the values agreed within 80 per cent by eliminating the month of February 1954, when two-thirds of the total precipitation fell in one snow-storm. The chloride content of the dustfall was reduced by precipitation. The lower sulphate content indicates that some of the sulphate in the blank run might have come from a source (possibly ground dust) other than fly ash.

3. *Summary of Two Atmospheric Surveys*

(a) As shown in Table XI, average concentrations of SO_2, dust, and organic aerosols were lower in the operating period than in the blank run, possibly owing to changes in meteorological conditions, although the

dustfall was increased during the operating period.

(b) The SO_2 levels at varying distances downwind from the plant showed that the maximum levels were lower than calculated for dispersion from the boiler house stacks and were safe for persons and vegetation.

(c) The suspended particulate matter is below the level calculated for dispersion from the boiler house stack and is comparable to an area of low pollution.

(d) The organic aerosols are well below the damaging limit, 0.04 vs. 0.35 mg./cu.m.

(e) The dustfall was increased after the plant started and is characteristic of an area of low concentration.

Garden Plots

As shown in Table II, sensitive plants will be damaged by a low concentration of SO_2. Accordingly consultants on pollution have suggested that garden plots be suitably placed and examined to observe if one or more plants are marked by an excessive emission of fume. In 1953 and each subsequent year, four garden plots were laid out in the positions marked on Fig. 6, each plot being downwind from an area having an effluent. The plots were prepared each spring for planting and after fertilization were stocked in an identical manner with a selection of sensitive flowers and vegetables. In the spring of 1954, an additional plot, containing gladioli, zinnias and petunias, was placed in front of the administration building.

Plants in all plots, except No. 2, remained healthy. The 1954 inspection showed slight gas damage in No. 2 plot, downwind from the incinerator, especially to the leaves of gladioli. Apple trees within 200-300 feet of the incinerator were also damaged in the growing season. The period of damage coincided with poor burning conditions in the incinerator and after correction the plants in No. 2 showed steady recovery during the summer. Again in 1956, slight damage was shown on the gladioli, zinnias, petunias and tomato plants in the plot near the incinerator but since the removal of the incinerator there has been no deposit of soot on the flowers or leaves of garden plots as noticed in former seasons when the incinerator was operating. The apple crop was also excellent.

It is proposed to continue with garden plots and to examine susceptible plants each year. Damage from contaminants leaving the nylon intermediates and other chemical plants to be operated at Maitland Works can be quickly seen. The wind direction and velocity will continue to be recorded so an immediate check can be made for the source of any pollution that might arise despite the safeguards.

Incinerator

The organic residues and tars from the nylon intermediates plant were burnt in an open-pit incinerator, situated some distance behind the process buildings. Every attempt was made to accomplish complete combustion with a minimum discharge of

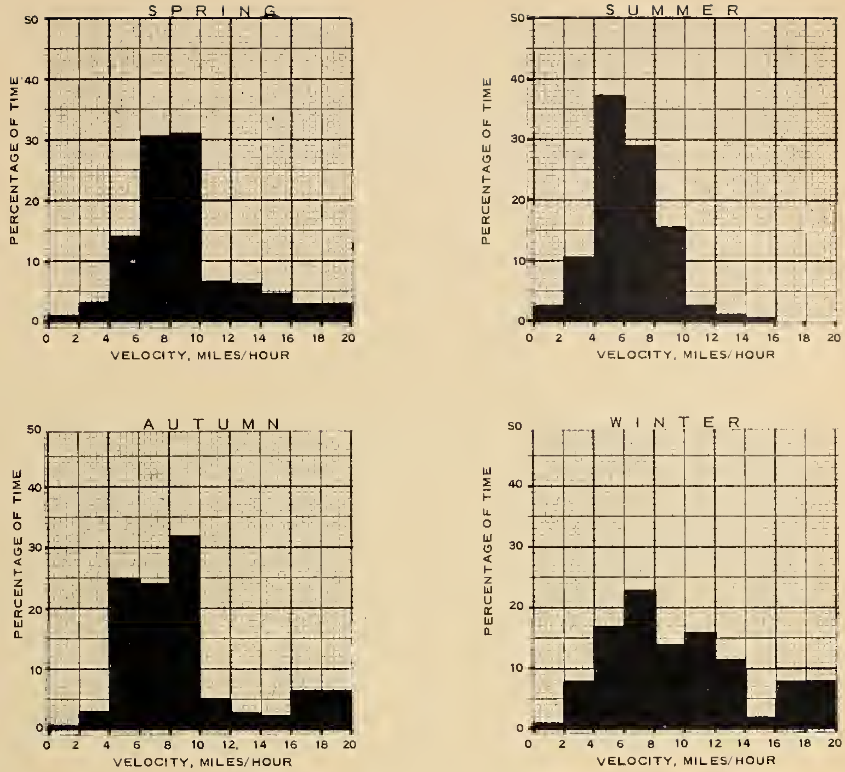


Fig. 4. Wind velocities at Maitland works, 1954.

Table VII.—Comparison of Dust Concentrations (milligrams/cubic metre)

Winter Values	Maitland				McGregor	Cincinnati (Residential area)	Leicester (30 mi. away)
Wind Direction	NE	SE	SW	NW			
Aerosols	0.124	—	0.67	0.051	0.073	0.280	0.025

Table VIII.—Comparison of Dustfall Concentrations tons/(square mile) (month)

Maitland	Outside Toronto	Toronto Summer	Toronto Winter	Windsor Summer	Windsor Winter
13	20	58	98	36	53

Table IX.—Average Dust Concentration by Wind Sector (milligrams/cubic metre)

	Wind Sector NE	SW	NW
Blank period	0.12	0.07	0.05
Operating period (winter)	0.10	0.09	0.04

Table X.—Average Dustfall Compositions (tons/(square mile) (month)

Period	Total Fall	% of Total soluble	insoluble	% of Soluble Cl	S	Ca	Tar	% of Insoluble Carbon	Ash
Blank run	12.9	19	81	22.2	29	16.9	1.6	28.5	60.0
Operating run									
(winter)	25.3	33	67	3.1	16.7	8.5	0.7	25.3	74.0
(summer)	16.5								

solids, noxious gases or odour. In practice, some nuisance within the plant site was created by the fumes during adverse weather conditions.

Immediately a study was started to determine if the organic wastes could be disposed of more efficiently. It was found to be economic to recover the bulk of the heat of combustion by burning the wastes in a suitable burner under a conventional boiler in the boiler house. Over a given feed range, the designed burner was satisfactory for lighting the coal fire when steam and atomized oil were used with the organic wastes. Below the minimum rate the organic wastes caused pulsation and made it difficult to control a constant rate of burning, while above the maximum rate an unstable flame occurred.

In 1956, the incinerator was removed and organic wastes were disposed of on a continuous basis while tars were fed intermittently. Under controlled burning, combustion appears to be complete and the appearance of the stack is normal i.e. no additional colour or odour.

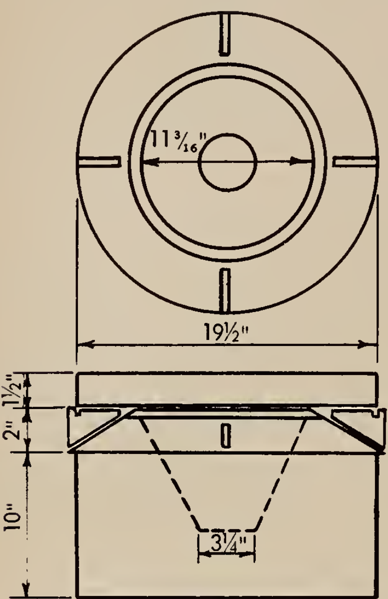


Fig. 5. Detroit dustfall collector.

Table XI.—Comparison of Blank Run and Operating Period

	Unit	Blank Run Plant not operating	Operating Period Plant operating
SO_2			
overall average*	p.p.b.	0.3 (summer)	0.5 (summer)
	p.p.b.	2.3 (winter)	1.8 (winter)
max. conc.*	p.p.m.	0.17	0.15 (summer)
			0.21 (winter)
Dust			
monthly mean conc.	mg./cu.m.	0.08–0.20	0.06 (summer)
			0.09 (winter)
max. conc.	mg./cu.m.	0.48	0.35
Organic Aerosol			
monthly mean conc.	mg./cu.m.	0.04–0.07	0.04 (winter)
max. conc.	mg./cu.m.	0.27	0.35
Dustfall			
range	tons/(sq. mi.) (mo.)	8.7–21.5	16.5 (summer)
average	tons/(sq. mi.) (mo.)	12.9	25.3 (winter)

*Monthly average SO_2 level is too dependent on wind direction; maximum concentration for 30 minute period in blank run and 60 minute period for operating period.

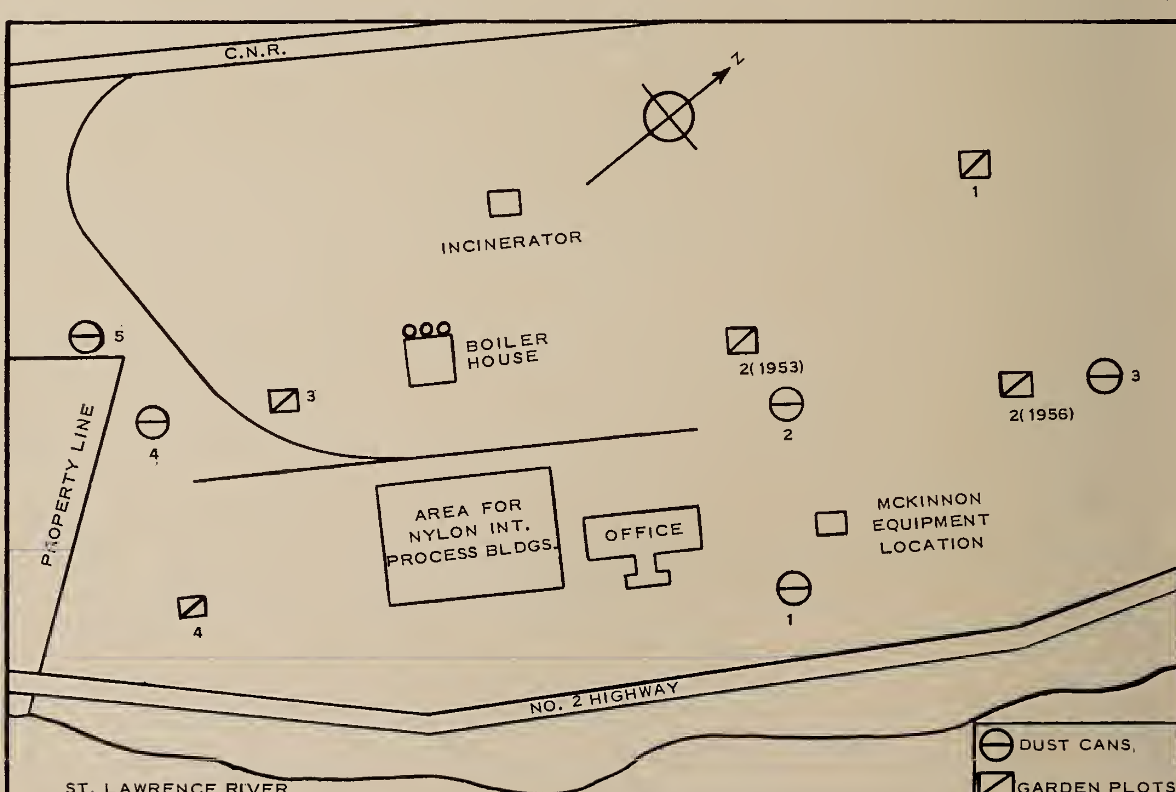


Fig. 6. Location of dust cans and garden plots.

Fume Abatement System

The reddish-brown appearance of the emissions from a number of vent stacks in the nylon intermediates area and from the nitric acid plant would appear unsightly as well as being a nuisance owing to their corrosive nature. This colour is caused by nitrogen dioxide (NO_2) which with nitric oxide (NO) accounts for 0.12 to 49 weight per cent in individual emissions. The question of reducing the oxides of nitrogen to a safe limit was carefully examined during the design of the nylon intermediates plant and as a result of a literature search, what appeared to be the most effective process for reducing the colour was investigated in a pilot plant. Based on the results of tests covering the absorption of NO and NO_2 in an alkaline solution, a full scale plant was designed, erected and operated.

The fume abatement unit consists of a piping system for collecting the low pressure fumes from tanks and process equipment in process buildings and delivering them to a blower and then to an absorber which also receives high pressure reaction off-gases from the nylon intermediates and nitric acid plants. Dilute caustic solution is circulated through the large absorber, 8-ft. in diameter with 41-ft. 6-in. of dumped 2-in. ring packing. In performance, the colour of the effluent gases was considerably reduced. Later a waste liquor containing dilute ammonia and caustic, was tested and it was found that a heavy white plume containing finely dispersed ammonium salt particles was discharged from the absorber. The solid particles were very small, about 0.1 to 10 microns in diameter, and they required a suitable scrubber for their removal. A wet scrubber of the Venturi type, was considered most suitable for removing the fine particles.[19] This scrubber consists of a Venturi throat through which the gases pass at high velocity and at the same time come in intimate contact with water which is widely dispersed in small droplets after it enters the throat. A pilot Venturi scrubber was tested and the results showed that the bulk of the white fume could be removed. A Venturi scrubber, with attached separator to collect the liquor, was installed and successfully operated. The effectiveness of the Venturi scrubber was quickly demonstrated when water was added — then the white discharge leaving the clean up unit was rapidly reduced in volume and density. A year after first adding ammonia liquor, a careful examination was made of the entire fume abatement system to be certain that solid ammonium nitrite, an unstable compound formed in the absorber, was not deposited on the equipment. Ammonium nitrite, in the solid state but not in dilute solutions, will quickly decompose and detonate. As the examination did not reveal the presence of any solid ammonium nitrite, this equipment should continue to run in a safe manner. As safety is such an important word in the Company, periodic inspections will be made of the new removal unit.

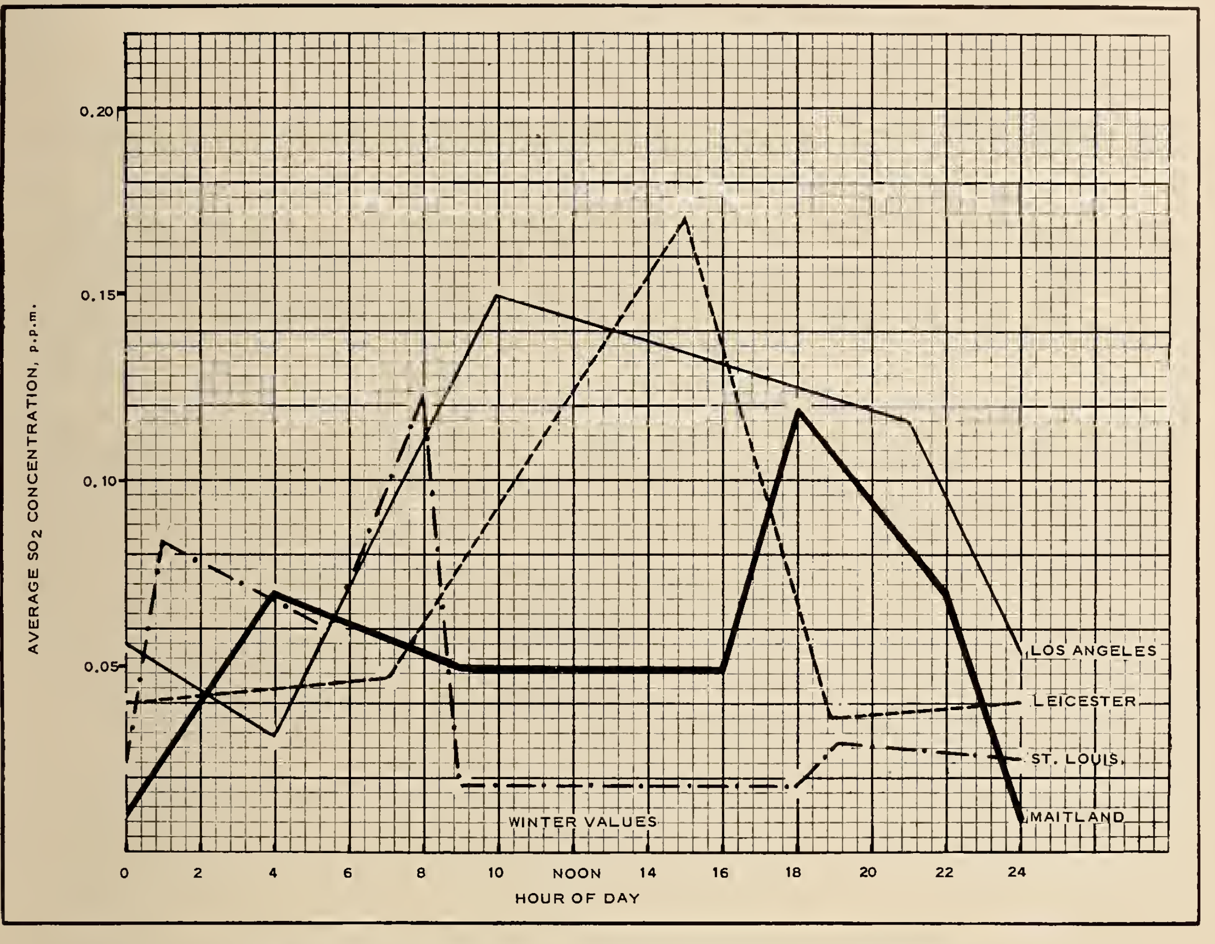


Fig. 7. Diurnal variation in SO_2 concentrations for various locations.

This seems to be the first fume abatement system used in Canada for the reduction and near elimination of oxides of nitrogen from effluent gases leaving a nitric acid plant. Details of the experimental tests, design of the equipment, and its operation were given at the 1957 Annual Conference of the Chemical Institute of Canada.

Conclusions

The steps taken by the Company have shown that each contaminant is released at such a controlled rate that the maximum ground level concentration is below the toxic or threshold limit to individuals and vegetation. The two atmospheric surveys showed only an increase in dustfall, not of SO_2, suspended particulates or organic aerosols. The estimated maximum SO_2 ground concentrations, at various distances downwind from the source, were within the limits set by empirical equations. Occasional and objectionable fumes from the incinerator were eliminated by burning the organic wastes in the boiler house. Perhaps the most interesting story associated with pollution control at Maitland is that of the reduction of the oxides of nitrogen and elimination of the brownish-red colour from the fumes leaving the nitric acid and nylon intermediates plants. This process could be applied to other nitric acid plants.

The success of pollution control is indicated by the establishment of a recreational area on the St. Lawrence River by the employees, on a site which is both downwind and downstream from the plant.

Conversion Factors

The following are the useful conversion factors for units employed in atmospheric pollution:

1 microgram /cu.m. $\times$ 0.36	= 1 grain /cu. ft.
1 milligram /cu.m. $\times$ 357	= 1 grain /cu. ft.
1 micron $\times$ 3.9×10^{-5}	= 1 inch
1 part per million $\times$ 10^{4}	= 1 per cent.
1 ton /stack day $\times$ 83.3	= 1 lb. /hr.
1 metre /second $\times$ 2.2	= 1 mile /hr.

References

1. Arch. Ind. Hyg. and Occ. Med., 9. 6 (1954).
2. "Nitrous Fumes", Leaflet No. 5, Dept. of Scientific and Industrial Research of Great Britain, Her Majesty's Stationery Office (1939).
3. Cunningham, O. C., Addington, L. H. and Elliot, L. T., J. Agr. Research, 55, 381 (1937).
4. Katz, M., Ind. Eng. Chem., 41, 2450 (1949).
5. Thomas, M. D., Hendricks, R. H. and Hill, G. R., Ind. Eng. Chem., 42, 2231 (1950).
6. Zimmerman, P. W., Proc. First National Air Pollution Symposium, Stanford Research Institute, Los Angeles (1949).
7. Magill, P. L., Holden, F. R. and Ackley, C., "Air Pollution Handbook", New York, McGraw-Hill Book Co. (1956).
8. Bosanquet, C. H. and Pearson, J. L., Trans. Faraday Soc., 32, 1249 (1936).
9. Bosanquet, C. H., Carey, W. F. and Halton, E. M., Proc. Inst. Mech. Engrs., (London) 162, 3, 355 (1950).
10. Sutton, O. G., J. Roy. Meteorol. Soc., 73, 426 (1947).
11. Thomas, M. D., Hill, G. R. and Abersold, J. N., Ind. Eng. Chem., 41, 2409 (1949).
12. Gosline, C. A., Chem. Eng. Prog., 48, 165 (1952).
13. Landsberg, H. E., Meteorol. Monograms 1, 4, 7 (1951).
14. Katz, M., Eng. J. (Canada), 38, 4, 426 (1955).
15. Katz, M., Amer. Ind. Hyg. Assoc. Quart., 13, 4 (1952).
16. "Atmospheric Pollution in Leicester", Her Majesty's Stationery Office.
17. Cholak, J., Proc. Second National Air Pollution Symposium. Pasadena (1952).
18. Allcut, E. A., Eng. J. (Canada), 30, 154 and 164 (1947).
19. Johnstone, H. F. and Roberts, H. M., Ind. Eng. Chem., 41, 2417 (1949).
20. Newbury, B. C., Ontario Research Foundation (private communications).
21. Katz, M. The Sarnia Survey, Paper No. 55 — APC — 4, The American Society of Mechanical Engineers, New York (1955).

Canadian Overseas Telecommunication Facilities

(Continued from page 48)

arate system, such service being provided by utilization of the telex network. The consequent possible existence of carrier systems, microwave, and scatter links in a telex connection, should tend to force the use of telegraph transmission providing for automatic repetition of transmission when a "hit", "fade", interruption or noise causes a mutilation of the transmission. Therefore, from the foregoing, it can be stated that the future of overseas telecommunications would appear to offer great interest to the engineer, and it will require substantial effort, and what might be called original thinking, by our engineers, if Canada is going to make its full contribution to future development of its overseas telecommunication services.

References

(1) "Telegraph Codes and Code Convertors"—I.E.E. Paper No. 1585 T. Hayton, C. J. Hughes and R. L. Saunders.
(2) "Transatlantic Cable System: Planning and Overall Performance" E. T. Mottram, R. J. Halsey, J. W. Emling and R. G. Griffith (Symposium Paper).
(3) "System Design for the North Atlantic Link" (Symposium Paper) H. A. Lewis, R. S. Tucker, G. H. Lovell and J. M. Fraser.
(4) "A Submarine Telephone Cable with Submerged Repeaters" — (Bell System Technical Journal, 1951) J. J. Gilbert.
(5) Power Feed Equipment for the North Atlantic Link (Symposium Paper) G. W. Meszaros and H. H. Spencer.
(6) "Cable Design and Manufacture for the Transatlantic Submarine Cable System" (Symposium Paper). A. W. Lebert, H. B. Fischer and M. C. Biskeborn.
(7) "Repeater Production for the North Atlantic Link" (Symposium Paper). H. A. Lamb and W. W. Heffner.
(8) "Repeater Design for the Newfoundland-Nova Scotia Link". R. A. Brockbank, D. C. Walker, and V. G. Welsby (Symposium Paper).
(9) "A new Deep-Sea Coaxial Cable"—I.E.E. Journal Vol. 2, October 1956. R. A. Brockbank and A. L. Meyers.

Battle River Steam Station

(Continued from page 57)

This does not include such special functions as ash removal, soot blowing or coal handling.

An interesting added feature is a television camera which views the flame in the furnace through a window in the top of the the boiler. The monitor is mounted on the vertical panel in front of the operator. In this monitor, the operator can view the torches lighting up in the corners of the boiler, and can see the flame conditions in the furnace. Besides being a very attractive item for visitors, it also is a valuable instrument for the operator.

The Future

The ultimate capacity of the Battle River station will be decided by the cooling water requirements, which places the limit at 120 Mw. if conventional steam installations are made throughout. This could be bettered if higher pressures and temperatures with reheat are adopted for the steam conditions of future installations, as this would reduce cooling water requirements per megawatt.

Again looking into the future, it appears that a second unit will be required at Battle River by the fall of 1962. Although the second 30 Mw. unit will undoubtedly be of conventional steam plant design, we are most interested in the development of a gas turbine using coal for fuel. It is not beyond the realms of possibility that the third installation at Battle River will be such a unit. As water cooling requirements for the gas turbine are small, such an installation would greatly increase the potential capacity of the Battle River station. We have been asked many times if we are considering atomic power. It is our belief that Alberta Utilities will not be interested in this new development for some time, in view of the abundance of coal and natural gas available for fuel at reasonable rates in our province.

DISCUSSION

of Technical Papers and Other Articles

AIR POLLUTION CONTROL AT NYLON INTERMEDIATES PLANT

H. R. L. Streight

The Engineering Journal, 1958, January, p. 69

Canadian Journal of Chemical Engineering.

E. B. Lusby*, M.E.I.C.

We have been privileged to hear Dr. Streight's paper on the control of air pollution at the Maitland plant of the Du Pont Company.

The approach to the problem of another industry starting operations in any area has been well described with figures showing the air pollutants before and after operations. It seems that pre-operations surveys are necessary as a guide in the design of new process equipment so that good neighbourliness is maintained with the former residents. It has been brought out however that sometimes lower figures for pollutants are obtained in the survey made after the operations have started than what was obtained in the pre-operations survey. Those contemplating the installation of new processes would have to keep this point in mind. It was also noted that the necessity of better design for incinerators was stressed and this can be an inspiration to all chemical plant designers.

Of particular interest was the application of garden plots at the Maitland plant. The location of these plots is important and it was brought out that such plots are a very effective and economical method for detecting and thus maintaining control of air pollutants. Dr. Streight and his company are to be complimented for their contribution to this important subject.

I would like to ask Dr. Streight a question . . . It was noted that the oxides of nitrogen that are evolved could be reduced by absorbing in an alkaline solution; could this be explained further and could Dr. Streight tell us the disposition of the solution?

Author's Reply

In reply to Mr. Lusby's question, a fume abatement system is operating at Maitland Works to reduce the oxides of nitrogen leaving the nitric acid and nylon intermediates plants to a value less than the threshold limits for human beings or sensitive plants. The design, operation and performance of the equipment were given in a paper entitled "Reduction of Oxides of Nitrogen in Vent Gases" at the 1957 Annual Conference of the Chemical Institute of Canada — this paper is being published in the *Canadian Journal of Chemical Engineering.*

Briefly, the vent gases are scrubbed in a large packed absorber with a dilute ammonia-caustic soda solution and cleaned in a following Venturi scrubber. An almost colourless effluent gas passes to atmosphere. 97% of the oxides of nitrogen are removed in the absorber and Venturi scrubber. The solutions containing ammonium nitrate and nitrite are sent to the St. Lawrence River and are of benefit to the health of aquatic life.

*Co-ordinator of Technical Training, Manufacturing Department, Imperial Oil Limited, Toronto.

BATTLE RIVER STEAM STATION

The Engineering Journal, 1958, Jan., p. 49

J. N. Ford, M.E.I.C. and W. I. McFarland, M.E.I.C.

E. B. Campbell†, M.E.I.C.

With the tremendous expansion of thermal electric generating capacity presently underway in Canada it is gratifying to those of us associated with the utility industry to see an ever increasing interest in this field of engineering by the Engineering Institute of Canada. I am sure that future annual meetings will hear more about thermal power generation and its associated problems.

We have heard a very interesting description of another of Canada's new thermal generating stations. It is interesting to note that because of the tremendous rate of load growth this utility has considered it to be economic and expedient to install in one unit capacity equivalent to the total capacity previously installed on that part of their system.

It is only recently that much attention has been paid to the burning of Western Canadian coals in pulverized form and very little information or experience is presently available on the problems associated with these fuels or their pulverizing and burning characteristics.

However, from preliminary information available, it appears that the various western coals which are similar in analysis do differ greatly in the fineness to which they must be pulverized for satisfactory combustion and low carbon loss, the primary air temperature required for satisfactory drying in the mills, and the coal/air mixture temperature necessary at the burners. In addition, these coals appear to differ greatly in their effect on steam temperature. It is very difficult, if not impossible, to predict the behaviour of these coals from standard laboratory test methods which have been established from, and are applicable to, other fuels which differ greatly in analysis from the Western Canadian coals. This indicates an urgent need for numerous full scale tests on existing pulverized fuel installations to provide the necessary design data for the many large plants presently in the planning stage by utilities in Western Canada. It is imperative that all test data and conclusions be distributed as widely as possible and be made available to all interested parties, both utilities and manufacturers.

(continued on page 92)

†Chief Mechanical Engineer, Saskatchewan Power Corporation, Regina.

ABSTRACTS

BASED ON CURRENT LITERATURE AND EVENTS

LUBRICATION WITH MOLYBDENUM DISULPHIDE FORMED FROM THE GAS PHASE

F. P. Bowden and G. W. Rowe, *The Engineer.* v. 204 n. 5311, Nov. 8, 1957.

Lubrication of surfaces at high temperatures is becoming of increasing importance, and since the conventional liquid lubricants break down at temperatures of a few hundred degrees centigrade, use is made of solid lubricants such as graphite, molybdenum disulphide and other lamellar solids. Firm attachment of solid films of these substances to the surface is important and if formed by chemical reaction this attachment can be improved. When the surface is heated in an appropriate gaseous atmosphere this is accomplished. Lubrication from the gas phase has the additional advantage that the film can be reformed in operation if the parts are surrounded by the gas.

It has been shown that if molybdenum disulphide is rubbed on to steel surfaces a thin film is produced which has good lubricating properties which continue up to reasonably high temperatures, and also that sintered molybdenum forms a low-friction coating when heated in hydrogen sulphide gas. Recent experiments have been made with pure molybdenum, initially heated to 1400° C. in a high vacuum to remove surface contamination. After cooling to room temperature the surfaces had a high coefficient of friction between them, $\mu = 2.0$, which rose with temperature until complete seizure occurred at 110° C. Purified H_2S gas was admitted at a low pressure (0.01 to 0.1 atmos.) and at room temperature. It was immediately absorbed on to the surface, reducing the friction to $\mu = 0.9$. When heated in the gas, chemical reaction took place and the friction between the surfaces fell to $\mu = 0.2$ at 800°-900° C. Specimens cooled after 20 minutes of heating in H_2S at 850° C were covered with a thick purple film of molybdenum disulphide which gave good lubrication. The film was stable and gave low friction in vacuum up to 800° C but above 900° C the film decomposed and friction rose rapidly. If the H_2S gas atmosphere is maintained the worn films can continuously be repaired during the sliding process.

An attempt was made to lubricate steel surfaces in this way. Molybdenum disulphide rubbed on to steel gave a fairly low friction, $\mu = 0.4$ *in vacuo*, and protected the surfaces from seizure up to 700° C - 800° C but the friction was high, $\mu = 1.5$ to 2. When the molybdenum coating was applied to the steel by a sputtering process it spalled off when heated in H_2S gas, due to the formation of iron sulphide within the discontinuous molybdenum layer, and friction coefficients were high. However, the application first of a protective nickel coating on top of a flash of copper to the steel specimens before applying the sputtered molybdenum permitted the formation of MoS_2 without chemical attack on the substrate metal and resulted in low friction coefficient.

These observations have provided further evidence that films formed by heating molybdenum in hydrogen sulphide as in carbon disulphide vapour can give low friction at high temperatures even *in vacuo*. If destroyed during rubbing the films are readily reformed in the hydrogen sulphide gas, so that in this atmosphere the surfaces will continue to give a low friction. In this manner a gas may act as an effective lubricant if it reacts with the surface to form a compound of appropriate structure.

WHAT'S IN THE LITERATURE (THE IMPORTANCE OF DOCUMENTATION)

F. T. Sisco, *Metal Progress*, v. 72 n. 4, Oct. 1957.

The tremendous massing of technical and scientific literature which is going on at an ever-increasing rate presents a very serious economic and often ethical problem. Searching of the literature is now so costly in the use of time of qualified people that it is frequently cheaper (for many small scale research problems) to get a direct answer by laboratory research than to find out whether someone has recorded his findings.

In 1952 the Library of Congress received nearly 40,000 scientific and technical journals and other serial publications which contained approximately 1,500,000 papers, applying only to engineering and science. While books can be excellently indexed and classified, periodical literature has not been so treated because of the diversity of publications and the great magnitude of the job. To conserve the time needed for literature perusal many excellent abstracting services have developed but although abstracts are valuable time-savers they have many faults. There is too much duplication, too much of a time lag between publication of the paper and the appearance of the abstract, much bad indexing and confused and uncertain terminology, and there are too many omissions. The free world prepares in the average year about 300,000 abstracts and the Soviet Union about 400,000 but duplication in this total amount is serious and only about one quarter of the available engineering and scientific literature is abstracted in any one year.

The output of technical literature has increased at a startling rate. The major American engineering societies publish in an average year about five times the number of technical papers published 20 years ago. In 1956, *Engineering Index* prepared 27,000 abstracts in all fields of engineering.

A threefold attack on the problem is needed. First, the development of a logical and uniform system of indexing based on semantic principles;

second, a logical system of classifying technical papers or abstracts which will permit them to be coded effectively and rapidly; and lastly the development of some system, preferably by the use of machines, which will rapidly locate and retrieve the coded literature.

The Society for Metals has initiated some studies and research projects dealing with metallurgical abstracts in an attempt to solve the problem as outlined above. They hope that it will spur other organizations in the engineering field to action in finding an answer to what is now one of the most pressing problems — making the literature readily available. Its solution will eliminate the economic factor of high cost and waste of manpower in repeating work which has already been done but which cannot be found, and the ethical question of reporting as new and original, data which should be credited to a previous investigator.

VACUUM METALLURGY

R. C. Bertossa, *Mechanical Engineering*, v. 79 n. 11, Nov. 1957.

Materials capable of withstanding high temperatures and corrosive environments are in demand in the petroleum industry and in the aircraft, missile and atomic energy fields. Titanium, zirconium, tantalum, columbium, and molybdenum all have exceptional properties which make them desirable for use in newly developed processes and industrial equipment where requirements are too severe for ordinary metals and alloys. However they have one common undesirable characteristic in that they are easily embrittled at elevated temperatures by contact with even small quantities of atmospheric gases such as oxygen and nitrogen, and also hydrogen. Rapid deterioration through oxidation also occurs at high temperatures.

The use of vacuum techniques in melting, heat-treating, joining and cladding not only protects against contaminating gases, but also promotes the removal of gases and other impurities from metals previously contaminated. This is termed "out gassing". Oxidation-resistant claddings are being developed for metals such as molybdenum, tungsten, tantalum, columbium and others in order that they may have protection in high-temperature service while their exceptional high-strength properties are utilized. Vacuum cladding appears to present the greatest potential for solution of this problem. It is used for producing high-strength clad plates for subsequent fabrication into pressure vessels which are subjected to corrosive conditions at high temperatures e.g. 1/16 in. of fine silver integrally and continuously vacuum bonded to 1 in. of austenitic stainless steel. There are large vessels now in chemical, petroleum, and paper-pulping service fabricated by vacuum cladding stainless steels, monel, nickel, and inconel on inexpensive low and medium-carbon steel plates. Vacuum brazing techniques are used to produce light-weight honey-comb sections of great rigidity and strength from thin stainless sheets for the aircraft industry.

Many advantages are obtained from the use of vacuum-metallurgical techniques. High vacuum effectively excludes atmospheric gases during the time the metal is at elevated temperatures. It can actually break down and remove oxide films previously built up on certain metals, cleaning and de-oxidizing the surfaces, Many non-metallic, some metallic, and most gaseous impurities are scavenged from metals, upon both vacuum melting and heating under vacuum without melting. In brazing of metals, vacuum techniques exclude oxidation from the interfaces, allowing uniform and complete bonding without fluxes. Vacuum can be used also to exert very high uniform pressures on the bonding interfaces, bringing them into intimate contact and thus insuring a uniform cross section of bond and highest strength of joint with a minimum of brazing alloy. In all operations, vacuum methods produce products which are bright and clean and, in many cases, need no further finishing. The metals produced by ordinary production practices normally contain defects such as segregations of nonmetallics, voids, entrapped hydrogen and other gases. When these defects and impurities have been removed by vacuum-melting or heat-treating, these common metals and alloys show remarkable increases in strength and other desirable properties for an increase in cost of only a few cents per pound.

On the other hand vacuum-metallurgical processes are more difficult to carry out, the equipment is intricate and skilled, meticulous operators are required to produce, heat-treat, join, and decontaminate the metals. However these particular problems are being resolved rapidly and many commercial processes are operating.

THE FIRE RESISTANCE OF PRESTRESSED CONCRETE

A. W. Hill and L. A. Ashton, *Civil Engineering*, v. 52 n. 617, Nov. 1957.

Fire resistance tests in Great Britain are carried out at the laboratories of the Joint Fire Research Organization, at Boreham Wood, where facilities exist for testing walls, floors, columns and beams up to 24 ft. span. Fire resistance is a measure of the ability of a constructional element to withstand heating of a specified intensity while performing its normal functions, so restricting the spread of fire in a building for a definite time. Fires of varying severity can be represented by tests of different duration, since a relation has been established between the amount of heat liberated by complete combustion of the contents of a compartment of a building and the corresponding test period. Observations are made continuously throughout the test to determine when the first critical point is reached, denoting failure of the specimen to act as a barrier to spread of fire.

In structural elements such as floors or walls which form the boundaries of a compartment of a building, failure may occur in three ways: (a) by heat conduction sufficient to ignite flammable material in contact with the surface remote from the fire; (b) by the formation of cracks and holes which will allow flames and hot gases to pass from one side of the element to the other; (c) by collapse. Beams and columns have only a load-bearing function in a building and their fire-resistance is given by the time from the start of the test in which failure by collapse occurs. The fire resistance of an element of structure is the time from the start of the test to the occurrence of failure as judged by any of the above conditions, and is generally given to the next lower of one of the following periods; ½ hour, 1 hour 2 hours, 4 hours, 6 hours.

Investigations in Great Britain so far have been confined to beams and floor members. Prestressed concrete members of a given type, span and load-bearing capacity, are likely to have a lower fire resistance than their equivalents in normal reinforced concrete for three reasons:

(1) prestressed concrete members have a smaller section and therefore less heat capacity;

(2) cold-drawn steel wire used for prestressing is more susceptible to high temperatures than mild steel, and it usually carries a stress which is a higher proportion of its ultimate strength than that in mild steel;

(3) continuity, which is more common with reinforced concrete, has a marked effect on fire resistance.

In assessing the fire resistance of prestressed concrete it can be assumed, as the result of experience in fire tests, that collapse due to failure of the steel is imminent when the temperature of the wires has reached 400° C. At this temperature the strength of the high-tensile steel is reduced to one half that at normal temperatures. By comparison, mild steel loses half its strength at a temperature between 500-600° C., and fracture at normal working stresses does not occur until in the region of 600° C.

In normal practice the high-tensile steel in prestressed concrete can often be given additional cover, as compared with reinforced concrete, without loss of economy, so that the inferior temperature-strength characteristics of high-tensile steel wires can be offset to some extent. With reinforced concrete the steel, to be most effective for strength requirement, has to be located as near the tension face as possible, and in such a position would be affected relatively quickly by fire. With prestressed concrete the wires are not so near the surface exposed to fire, and are often spread over the section. Provided, therefore, that adequate protection is offered by in-situ concrete, hollow tiles, etc., the strength of a prestressed member even with losses in the extreme wires, may diminish at a slower rate than expected. Additional fire resistance can be obtained by the use of protective coatings which reduce heat transmission to the wires and prevent spalling of the concrete as long as they remain in place.

At 150° C the tensile strength of high-tensile wires usually shows a slight increase but not as much as with mild steel. This characteristic is of less importance in the fire resistance of prestressed concrete and its subsequent residual strength than the effect of heat on the tension in the steel. The modulus of elasticity decreases by 6 per cent at 200° C. and by about 20 per cent at 300° C., which reduces the tension in the wires, while further reduction with rise of temperature is caused from relaxation of the steel due to creep. In addition it has been shown that the longitudinal expansion of hard-drawn wire is not linearly proportional to temperature and not recoverable for temperatures above 150° C., and this would cause a further loss of tension in the steel.

When steel in a loaded prestressed concrete beam is heated to between 200° and 300° C. an appreciable deformation can be expected, and on cooling the loss of prestress may be considerable although the recovery of strength of the high-tensile steel wire may be complete for temperatures up to 300° C. and considerable up to 400° C. Thus the behaviour of a prestressed beam which remains intact after damage by fire is less likely to be severely affected by a fall in strength than by loss of prestress due to reduction of tension in the steel.

Tests made to date have indicated the following tentative conclusions:

(1) Explosive spalling of unprotected beams, having no part of the section less than 2 in., is unlikely.

(2) Failure of a beam can be regarded as imminent when the mean cable temperature at any section reaches 400° C.

(3) A fire resistance of one hour can be obtained with a concrete cover to the cable of 1½ in., a fire resistance of two hours with a concrete cover of not less than 2½ in., and of four hours with a cover of at least 4 in. In order to obtain the four hour period it is necessary to incorporate mesh reinforcement round the prestressing steel to retain the cover in place.

(4) Collapse is likely to be gradual. Warning of failure is given by the development of a marked sag, which may increase visibly just before the end.

(5) There is little difference in performance between beams of rectangular section and beams of I-section designed for the same load and having the same cover to the cable.

(6) A beam longitudinally restrained may have a lower fire resistance than when simply supported.

(7) Even after a heating of about one half of that necessary to cause collapse, a beam will show an appreciable loss of prestress on cooling. A marked permanent deflection will be present after removal of the imposed load, but the ultimate strength may still be a high proportion of its original value.

(8) Protection may also be afforded by the addition of surface finishes adequately fixed to the concrete. Thicknesses of surface finishes to give an increase in fire resistance of about two hours are:

(a) 1 in. of vermiculite concrete slabs placed as a lining to the mould;

(b) 7/8 in. vermiculite gypsum plaster;

(c) ¾ in. sprayed asbestos.

BRITISH MOTOR TRANSPORT INDUSTRY

The Overseas Engineer, v. 31 n. 359, Nov. 1957.

The motor industry has contributed substantially to the overall growth in the British economy in recent years. In 1956 the output of cars, commercial vehicles and tractors was more than twice as great as that in 1938 (1,115,000 units compared to 455,000 units). As judged by the index of industrial production the motor industry's share is from 5 to 6 per cent.

Although there are some 50 companies engaged in the manufacture of vehicles and tractors, the five largest make about 90 per cent of the output of the industry. The "Big Five" producers (B.M.C., Ford, Rootes, Standard and Vauxhall) all make passenger cars and commercial vehicles, and B.M.C., Ford, and Standard are also in the tractor field. Of the 45 or so smaller concerns in the industry, 20 make passenger cars, 20 commercial vehicles, and the remainder specialize in battery electric vehicles. The automotive interests of the 20 smaller car manufacturers are mainly concentrated on the production of sports and large luxury cars. The 20 commercial vehicle makers outside the "Big Five" make the bulk of the heavy trucks and almost all the buses and coaches produced in the U.K. These are mainly non-mass-production items because of small volume output and large range of models.

The 50 vehicle and tractor manufacturers obtain their raw materials, accessories and components from about 4,000 separate suppliers so that the industry employs about 450,000 to 500,000 persons, of whom about one half are working directly for vehicle manufacturers.

The most striking development in the industry during the post-war period has been the expansion of exports from a pre-war level of some 110,000 units to 556,000 in 1956. This 5 to 6 fold increase compares with an approximate doubling in volume of total U.K. exports over the same period. Total automotive products now account for 12-13 per cent of U.K. exports compared with 4 per cent in 1938. Of the 9.5 million vehicles produced in 1946-56 over 55 per cent were exported.

Commonwealth markets have been growing comparatively slowly due to the number of vehicles in use being high in proportion to population or due to low income levels of the people. By contrast the West European market has been growing rapidly and steadily and is likely to continue doing so with the gradual coming into force of the Common Market and (perhaps) the European Free Trade Area. The U.K. makers' share in this market has declined substantially from the (admittedly exceptionally high) levels of a few years ago, due primarily to the efforts of the German motor industry. Germany is, by far, the strongest competitor to the U.K. in world markets and in 1956 U.K. vehicle exports at 461,136 were slightly exceeded by German exports, 484,598. German cars are very competitive both as regards product and price and the German industry has concentrated production on far fewer models and paid special attention to the servicing and spares availability in foreign markets.

It seems likely that the German and U.K. shares in world markets may further increase, and that the share in world vehicle exports of the United States and France will decline. The American industry is unlikely to be able to compete both because of the dollar shortage and especially because American design trends are more and more out of line with requirements in most other countries. The French industry's export prospects are not very good because of high unit costs of production.

The U.K. domestic market, long protected by high tariffs, has formed the base of the industry's expansion in recent years. The coming into force of the Free Trade Area is not likely to seriously affect conditions because of the difficulties facing foreign manufacturers in rivalling the local industry's servicing and spares facilities in its home market.

EARTHQUAKE RESISTANT CONSTRUCTION IN MEXICO CITY

J. H. Thornley and Pedro Albin, *Civil Engineering*, v. 27 n. 11, Nov. 1957

A survey of forty-seven buildings, by detailed examination after the recent earthquake of July 28, 1957, has led to some conclusions regarding earthquake resistant construction.

A common theory, heretofore, has been based upon resonant vibration, that is, if the frequency of vibration of a building comes into consonance with that of a shock, a build-up may result, which will wreck the best designed and most stoutly built structure. In the study of the damaged buildings a considerable uniformity was found in the location of maximum damage. It occurred in most cases between the third and fifth floors. The structural types of these buildings, their heights, and their space layouts varied through a wide range. There seems to be no observable relationship between the extent of damage and either the building height or structural type. The one factor which is consistent with the effects is that of type of foundation. The natural frequencies of all these buildings must vary widely yet the dissimilarity of frequencies does not seem to override the effect of the type of foundation.

Five main types were present, plain concrete raft, compensated concrete raft, mat on sectional wood piles (obsolete), mat on concrete piles, and mat hung from concrete piles by yokes and screws. All buildings resting on and locked to a concrete mat supported on attached long concrete piles driven to point bearing on the cemented sand stratum came through the quake practically unscathed. Soil waves due to earthquakes are the result of vibrations presumably active at great depths. The actual movement of large volumes, of soil is probably a surface phenomenon and may partly explain the failure of raft foundations without piles and the tilting of some buildings.

Some conclusions reached are:

(1) If a pile foundation is used, the piles should be battered (at least in three directions). It should be rigidly connected to the superstructure so that its damping effect on the shock waves can be fully developed.

(2) All secondary internal structural members, particularly curtain walls, should be designed to act as internal bracing for the main structural skeleton both in bending and in shear. Curtain walls should be of concrete diagonally braced, so that they can act as stiffeners to the main structural members. Diagonal bracing members will provide the cheapest and most effective safety feature. Wherever possible the connections between columns and beams should be knee-braced.

(3) In at least five instances, severe damage was suffered by adjacent buildings where each possessed a separate wall which adjoined the wall of its neighbour, instead of both sharing a mutual party wall. One wall in some cases acted as a battering ram buffeting the other. The walls of adjacent buildings should be tied rigidly together, or a protective space of two or more feet should be left between adjoining high buildings.

PAPERS OF THE INSTITUTION OF ELECTRICAL ENGINEERS

The Design of the Control Unit of an Electronic Digital Computer. M. V. Wilkes, W. Renwick, and D. J. Wheeler (2365)

The function of the control unit of an electronic digital computer is to provide the sequences of pulses, which, when applied to the store, arithmetic unit and other units of the machine, cause the orders of the programme to be executed. The paper discusses a number of related ways in which a systematic and flexible design for a control unit may be achieved. In one group of systems the order code is determined by the arrangement of diodes in a diode matrix, and in another by the appropriate threading of wires through a matrix of ferrite cores. The first part of the paper is concerned with logical design, and the second part with the practical design of a system using a ferrite matrix.

A Decimal Adder Using a Stored Addition Table. M. A. MacLean and D. Aspinall. (2389)

A serial decimal adder is described which accepts numbers in binary-coded form. The binary digits, which are handled in parallel, are decoded into a set of pulses which actuate a built-in addition table storing all the possible sums. A special form of number representation has enabled the adder to be constructed more economically than would otherwise have been the case, while the advantages of this type of adder have been retained.

The circuits use square-loop magnetic cores for all logical functions and junction transistors as pulse amplifiers.

INTERNATIONAL NEWS

The Soviet Union and the I.G.Y.

A VAST AMOUNT of work is being done by many nations all over the world during the International Geophysical Year (I.G.Y.), but nothing has aroused so much public comment as the launchings by the Soviet Union of the two Earth satellites known as Sputnik I and Sputnik II, which are part of the Soviet contribution to I.G.Y.

The first satellite, launched on 4 October 1957, was a 22.8 in. diameter sphere weighing 184 lb. It was made of aluminum alloy, highly polished, and filled with nitrogen. Coded signals were transmitted at 20.005 Mc/s. and 40.002 Mc/s. and were received up to 10,000 km.; four rod antennas, 7.9 to 8.5 ft. long, projected outside the spherical body. The initial time to complete one orbit of the Earth was about 96 minutes, the highest point reached (the apogee) being about 621 miles.

The second satellite, launched on 3 November, was a much larger and more complex unit, of which a diagram is shown here. The payload of Sputnik II was just over 1120 lb. and the orbit even more extensive than that of the smaller satellite; the apogee at the start of flight was about 1000 miles, but the orbit period was not very much greater at 103.7 minutes. Equipment carried included instruments for the investigation of cosmic radiation, and the ultra-violet and x-ray regions of the solar spectrum; an hermetically sealed chamber with a dog inside; radio telemetering equipment for relaying the results of measurements to the ground; transmitters and batteries.

It was estimated that Sputnik I would continue to travel around the Earth until about the end of 1957, but that the larger satellite should have a longer life because of its greater distance from the retarding effects of the upper atmosphere.

Scientific Observations

In addition to the existing observatories in the Soviet Union, a large network of optical and radio observing stations has been organized in various other territories from which information is sent to Soviet scientists. Many observations are also being made in other parts of the world.

Measurements of the intensity of the field of radio signals received from the satellites were made by continuous automatic recorders and by individual records made at definite intervals. The results have contributed to the knowledge of the absorption of radio waves in the ionosphere, including the areas which lie above the maximum ionization of the main ionospheric layer F_2 and are therefore inaccessible to ordinary measurements from the Earth's surface. Signals on the 15 metre band were received at distances far exceeding those determined by direct observation — up to 5, 7, and even over 10 miles. It is expected that the final analysis of data from the radio observations will bring further useful information about the ionization of the upper areas of the ionosphere and the absorption and propagation of radio waves therein.

A further field of observation is the investigation of ultra-violet radiation from the Sun, which is largely absorbed by the earth's atmosphere. Some observations have been made from high-altitude rockets, but the satellite is the first means of making prolonged observations under favourable conditions. Instruments for the observation of cosmic radiation (two counters mounted with axes relatively perpendicular) gave useful information on the intensity and distribution of this radiation.

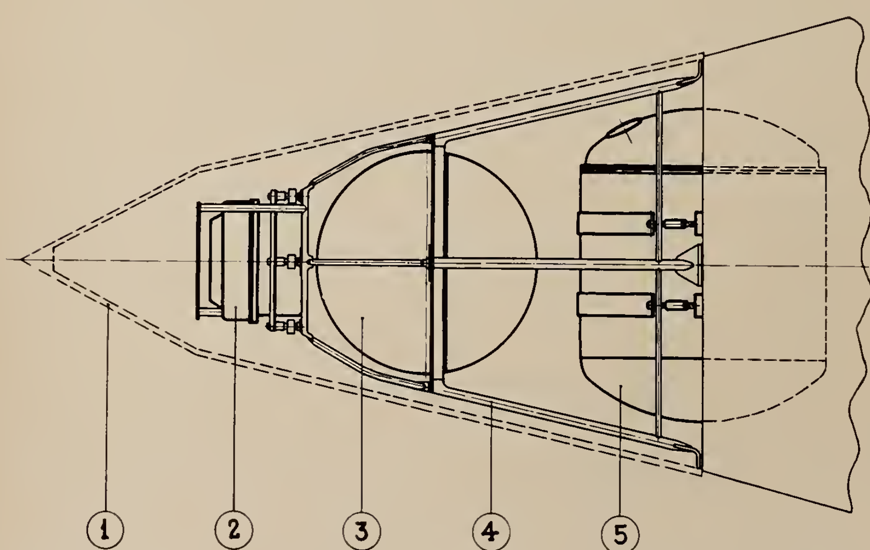


Diagram of the layout of equipment in Sputnik II. (1) Protective cone, discarded after satellite is on orbit. (2) Instruments for measuring ultra-violet and x-radiation from the Sun. (3) Sphere, resembling Sputnik I, containing instruments and radio transmitters. (4) Framework. (5) Chamber containing the test animal.

Biological Observations

Test animals, particularly dogs, have been used by Soviet scientists for several years to obtain data on physiological phenomena during short rocket flights up to altitudes between about 60 and 120 miles. The husky dog that travelled in Sputnik II was pre-conditioned to remain calm under the abnormal conditions of its flight so that necessary scientific measurements could be made. It is stated that the condition of the dog, Laika, remained "satisfactory" through the violent acceleration and subsequent protracted state of "zero-g" (or loss of the Earth's gravitational effect); observations were made for several days.

Future Projects

It is visualized that a manned expedition to the Moon will be achieved between 1960 and 1965, and to Venus and Mars by 1962-1967. Soviet scientific reports indicate that techniques are already well advanced towards this end.

(From articles in **Pravda** and other publications, reproduced in the **Soviet News Bulletin.**)

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

St. Lawrence Seaway and Power Projects

Progress by Ontario Hydro

Favourable weather for construction work prevailed throughout the month of November and good progress was made in all sections of the project. The work force at the end of the month totalled 4,450 persons.

Installation of generators in Ontario Hydro's half of the International power-house got underway in full scale manner during November, as technicians from the two major suppliers, Canadian General Electric and Canadian Westinghouse, arrived on the scene. Stator sections were placed in generator pits for units 1, 2, and 3, while work also was in progress on winding of the stator for No. 1 unit. Stacking of No. 3 rotor also was commenced.

Meanwhile, in turbine erection, the speed ring was placed for the sixteenth and last unit. Turbine units Nos. 1 and 3 were readied for installation of the runners. The guide vanes for turbine units No. 2 and 4 were in place and the outer head cover had been installed in No. 2 unit.

Concrete placing had been in progress throughout the month over the entire power-house structure. Construction of the transformer pocket walls was well underway with two completed. At month end, the total concrete placed amounted to 45,000 cubic yards. Excavation of earth and rock in the tailrace area continued with the total excavation for the power-house area amounting to 1,737,500 cubic yards. All the upstream main grout curtain had been completed.

Work on Cornwall dike was finished by month end. Trimming and placing of rip rap on the upstream face and granular material on the downstream face, were carried out. A total of 5,000,000 yards of compacted glacial till and 300,000 cubic yards of rip rap had been put into the dike.

Channel improvement work continued with few interruptions throughout the month. Two dredges were working in Chimney Island channel and making favourable progress. In the Galop Island reach, a dredge was working each end of the Galop cut. Two other dredges were operating in the channel for Lotus Island. At Iroquois Point, most of the perimeter cofferdam had been removed. Dry excavation was nearly completed at Point Three Points.

All house moving along the north shore of the river to be flooded for the power development, was completed during the month of November. Final house moving operations also were completed in Morrisburg in the month, marking the clean-up of this extensive program to transport more than 530 homes to new sites.

Progress by NYSPA

During November, five construction contracts were virtually completed, one for rehabilitation of the Massena-Taylorville transmission line, one for clearing the sites of the Barnhart - Plattsburgh transmission project facilities, one for the bridges on state highway route 345 and Franklin Road in Waddington and two for relocation of state highway routes 37 and 37B and relocation of River Road on each side of Massena intake. Concrete placement for all project structures now exceeds 1,916,000 cubic yards or 93 per cent of the total requirement. Excavation exceeds 48 million cubic yards or 88 percent of the required total. Employment averaged 4,990 for the month.

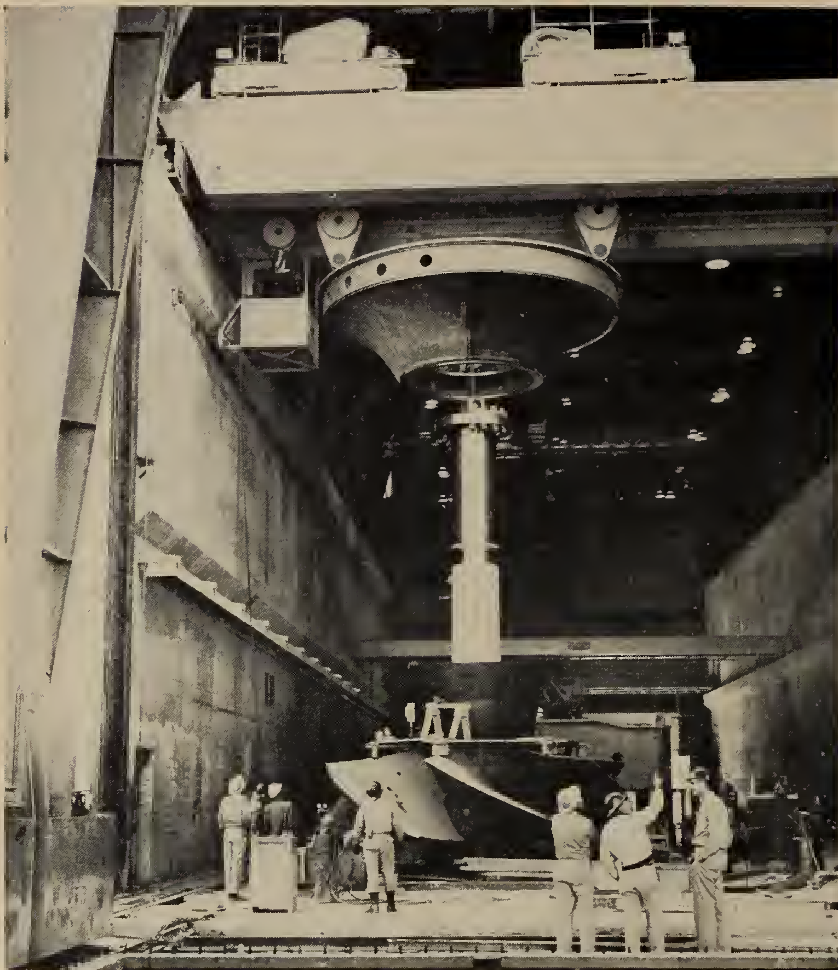
Concrete placement at the Barnhart Island power-house continued on schedule. During November 49,000 cubic yards were placed, bringing the total to date to 921,000 cubic yards or 95 percent of the required total, within the cofferdam. Excavation in the tailrace was in progress. Installation of electrical facilities in the power plant and switchyard was progressing. Stringing of seaway feeder conductors across river was completed.

At Long Sault dam, placement of 16,400 cubic yards of concrete during the month brought the total to date to 587,500 cubic yards, thus completing stage II concrete placement for the spillway section, the spillway apron, the roadway and the upstream crane girders. The temporary vehicular tunnels through blocks NB7 and NB9 were plugged. Final excavation and general clean-up of the stage II area was in progress.

At Iroquois dam, removal of stage II cofferdams and clean-up of the construction area continued. At Massena intake, pressure testing of the permanent Alcoa and Massena water supply lines was completed.

Channel improvement work at Sparrowhawk Point, Toussaints Island, Point Three Points and at Ogden Island continued. Channel improvements on the entire project were 93 per cent completed. Relocation of Norwood and St. Lawrence Railroad facilities continued on schedule.

Good progress was being made on construction of the Barnhart-Plattsburgh transmission project. Foundation work was in progress on the Plattsburgh substation and on the footings for the transmission line towers for the Reynolds power supply and the Barnhart-Adirondack transmission line north extension.



St. Lawrence Power Dam. An intermediate headcover is lowered over the main shaft into position in the runner assembly for Unit 32.

Progress by SLSA

Though employment on locks for the Canadian seaway operations, was somewhat reduced in November, due to the closing down of some concrete placing operations, increase in employment on bridge erection and lock gate installations, and favourable weather, prevented any sharp curtailment.

Water was let in at the Iroquois lock and the operation of the lock was tested by allowing vessels to pass through it on October 22. Navigation was closed for the season on December 7.

At the upper Beauharnois lock, 12,000 yards of earth and 41,000 yard of rock were excavated in November, bringing totals to 544,000 yards and 1,100,000 yards, respectively. By the end of the month, 180,000 cubic yards of concrete or 65 per cent of the total had been placed. The upper gate section was completed and about half of the lock chamber walls built to full height.

At the lower Beauharnois lock, with little excavation remaining to complete, some 220,000 cubic yards of concrete had been placed to month end, or about 75 per cent of the total. Some 30,000 yards were placed during November, practically completing the chamber section and bringing the lower gate structure to 80 per cent of completion. Concrete placing operations would soon be closed down for the winter.

On the Cote Ste. Catherine lock, with some 95 per cent of the concrete placed, mixing and placing from the central plant had been suspended, with completion to be carried out where necessary by ready-mix concrete. Preparations were under way for machinery and gate installation.

With 98 per cent of concrete for the St. Lambert lock placed by end of November, the balance would be supplied by ready-mix. Some 168,000 yards were excavated during November. With the erection tower and guy derrick in place, erection of the lift-span for Victoria bridge was commencing. The derrick was being set up for installation of lock gates and some of the gate machinery was being installed.

Elsewhere on bridges, jacking continued on the Jacques Cartier bridge with between 6 and 10 feet of the lift completed to date. A start had been made on erection of the lift span on the CPR-New York Central rail bridge at Caughnawaga, while at the south end of the Mercier bridge a start had been made on some of the roadway spans between the bridge piers. Excavation was under way for the Valleyfield bridge over the Beauharnois canal.

On the four piers for the Nuns Island Bridge awarded to Atlas Construction Company by National Harbours Board last summer, two were completed and the remaining two at the river's edge were well advanced to some 18 feet below final elevation.

It was announced during the month that Charles Gavsie, president of the Canadian Seaway Authority, would resign his position to resume practice of the legal profession in Montreal.

Progress by SLSDC

By end of November, progress on navigation channels and locks on the American side was tapering off as contracts were completed or nearing completion. Labour force had fallen to about 1,700 persons. At Eisenhower lock installation of mitre gates was proceeding, while the upstream emergency flap gate was installed. The project was 85 per cent complete with only machinery installation and access roads remaining to complete.

At the Grasse River lock installation of both mitre gates was nearing completion. With 90 per cent of the project done, work remaining was mostly excavation and cleanup.

On the Long Sault channel mainland section only some 400,000 cubic yards of excavation remained to complete the work. The project had reached 98 per cent of completion, with everything west of the Eisenhower lock practically finished.

Dredging was under way for three sections of the south Cornwall channel with a little more than a third of the yardage completed.

Testing of Iroquois Lock

Testing the machinery that will operate the Iroquois lock, first navigation structure to be completed on the seaway, has been going forward daily at this most westerly of the seven new seaway locks.

Due to the control of the St. Lawrence above and below Iroquois lock which will go into force in 1959, the Iroquois lock will operate at a head of from six feet to around one foot, the latter figure being achieved by gradually raising the water from the new levels over a period of several years. (Water level in the power pool will be initially 238 feet above sea level, while that in the river upstream of the Iroquois lock and dam will be from 244 to 248 feet above sea level.)

For the first two months of the 1958 season, however, the sector gates have been designed for and will probably operate against a head of 22 feet of water—believed to be the highest head of free-flowing water against which such gates operate anywhere in North America. For the Iroquois control dam will hold the waters leading upstream to Lake Ontario to a level of a little over 240 feet above sea level and the water downstream before the flooding stand at approximately 220 feet above sea level.

When the present stage of testing has been completed, the stop-logs will be removed by the stiff-leg derricks which stand permanently at each end of the lock. Then 20 million gallons of water will flow into the chamber.

Turbo Generator Installed at Halifax

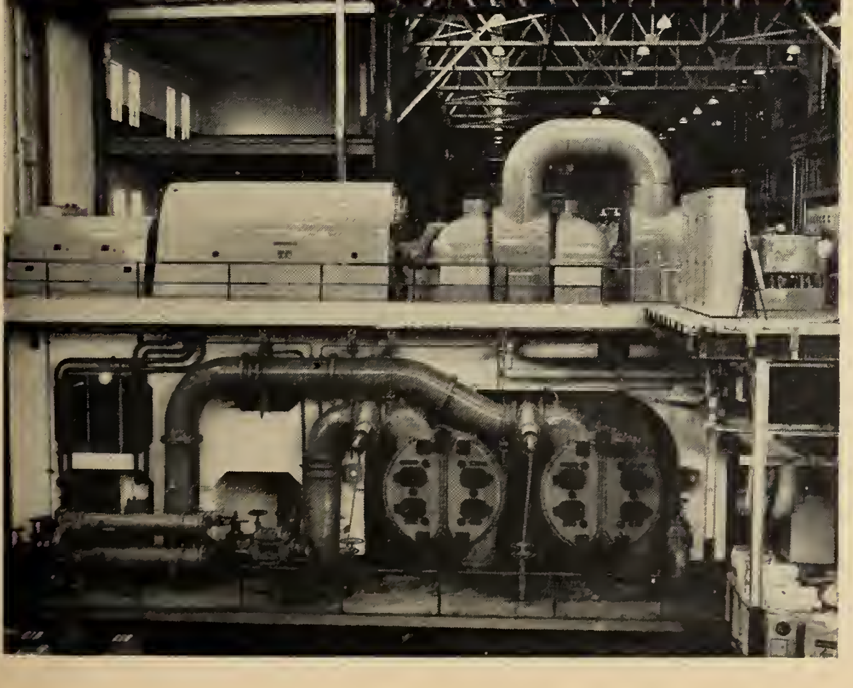
A 67-000-horsepower turbo generator installed at the Water Street thermal generating station of the Nova Scotia Light and Power Company Limited was commissioned on October 4, 1957.

Another 50,000-kilowatt turbo generator will be installed in 1959, to complete the development at the Water Street site. Planning is well advanced for the development of a new site at Tufts Cove, on the Dartmouth side of the harbour, which will have an ultimate capacity of approximately 500,000 kilowatts. During the next five years the Company plans to spend $40 million for new generating and distribution equipment. These plans were disclosed by the president of the Company, J. C. MacKeen, at the ceremonies opening the new plant.

He also talked of co-operative action of principal power utilities in the Maritime Region on the problems of electrical supply, including an interprovincial transmission grid. This cooperation is encouraged by the Power Committee of the Atlantic Provinces Economic Council.

The effect of the new plant is that after peak demand has been met this winter, there will be more than 30,000 kilowatts available for new industry and further demands, Mr. MacKean said.

Plant No. 6 at Water Street, Halifax.



It provides another market for Nova Scotia coal.

The building is supported on steel bearing piles, penetrating through overburden to solid rock. It is of a height equivalent to a 12-storey building and has structural steel frame.

The coal handling system is designed to unload the fuel mechanically from rail cars, crush it at the rate of 200 tons per hour, and transfer it by conveyor to the bunkers.

The cyclone fired steam generating unit is the first one of its type installed in Canada. It was developed by Babcock Wilcox Company to burn low grade bituminous coals which normally have a high content of low fusing temperature ash. It is also suitable for burning alternate fuels or fuel combinations.

The unit has a steam capacity of 450,000 lb. per hour continuous, or 500,000 lb. per hour on peaks. The operating steam conditions at the superheater outlet are 925 p.s.i.g. and 915° F. At maximum continuous rating the unit consumes 21.4 tons of coal per hour at an efficiency of 90.06 per cent. Running at full load the boiler will burn 513.6 tons of coal or 70.8 gallons of Bunker "C" fuel oil per day.

The instrument panels for both the new No. 6 plant and the future No. 7 plant are located together on the operating floor. The boiler control system is of the pneumatic type, manufactured by the Bailey Meter Company.

The No. 6 turbo-generator consists of a 49.5-Mw., 3,600-r.p.m. turbine, driving a 40/45/49.5 Mw., 13.2-Kv., 60-cycle, 0.85 p.f. hydrogen-cooled generator with gear driven exciter and pilot exciter, connected to a 60-Mva, 69/1.32-Kv., main step-up transformer and a 5-Mva., 13.2/2.3-Kv. auxiliary transformer. This equipment is operated as a unit. The generator is controlled from the control room.

The station service system used here has been designed so that the station may be operated on either the "parallel plant" or the "unit plant" idea. The No. 6 unit will operate as a unit plant at least until the commissioning of No. 7 boiler, that is it will supply power for its own auxiliaries directly from the generator terminals. Two voltages are used for the supply to the station, 2,300 volts for large motors and 575 volts for small motors, lighting transformers, etc.

New Building for Ecole Polytechnique, Montreal

The expansion program of Polytechnique, is the result of many years of effort. Back in 1948, at the time the institution was celebrating the 75th anniversary of its foundation, there was published a study of future enrolments which sounded the alarm. The next few years rapidly showed that the estimates of 1948 were so definitely on the conservative side that, in 1952 a second and more serious alarm was sounded. The evidence was received with sympathy everywhere and the case was settled generously in an announcement made in June 1954 by the Honorable Maurice Duplessis, Prime Minister of the Province. With the guarantee of a first grant of 6 to 7 million dollars, * the board of governors launched the project based on preliminary building studies already made in 1952. The program as defined three years ago is now on schedule and staff and students will be installed in their new quarters during the summer of 1958.

The new, modern building is erected on the campus of the Université de Montréal, located on the north slope of the Mount Royal, overlooking north west Montreal and suburbs. The structure provides about 500,000 square feet of floor space and has a volume close to 7,500,000 cubic feet. It more than doubles the dimensions of the existing facilities on Saint Denis Street in downtown Montreal. Its completion by 1958 will greatly relieve the situation experienced in 1956, whereby 900 students were accommodated within the same facilities available ten years ago to 375 students. Last fall, again, every available square inch was very precious as the enrolment reached close to 1,000.

The building has the form of an H with a double crossarm, the north leg having a length of 460 feet and the south, 570. The width of the structure is 290 feet except in the center axis where it reaches over 400 feet. The front wing accommodates the administration, the library, the students quarters and most of the lecture and draughting rooms. The other wings accommodate the other departments, useful space distribution being as shown in the accompanying table.

The building is erected on a slope and is generally four storeys high with intermediate sections at five and six storeys. Vertical circulation is assured by three passenger elevators, two freight elevators and one

*Since that time, the provincial government has passed legislation bringing the amount to $9,500,000.

Distribution of Space to Departments

Strength of Materials	19,000 sq. ft.
Mechanical Engineering including the Heating Plant	34,000 sq. ft.
Hydraulics	33,000 sq. ft.
Public Works Laboratory	18,000 sq. ft.
Metallurgy including ore dressing	24,000 sq. ft.
Electrical Engineering	45,000 sq. ft.
Physics	30,000 sq. ft.
Chemical Engineering & Chemistry	60,000 sq. ft.
Geology and Mining	34,000 sq. ft.
Library	26,000 sq. ft.
Administration	15,000 sq. ft.
Classrooms	90,000 sq. ft.

escalator, which serves the front wing, originating near the students' entrance in their own quarters and locker room.

The architectural treatment is very simple and follows the modern trend. The material used is a very light beige brick, similar to that used in the university's main building but, while the university's appearance has a tendency to show the vertical structure, the new building adopts the more up-to-date concept of horizontal geometric lines. This has the advantage of almost unlimited possibilities in window space and provides very adequate natural lighting of the interior.

The front wing is the only one treated in a special manner, with suspended ceilings and plaster finish walls. The other wings which contain the laboratory facilities are provided with the bare haydite cement block and no treated ceiling, thus leaving the services uncovered and assuring easy access to them for maintenance and possible changes. The only permanent partitions are those of the main circulation halls and corridors; all other haydite block divisions, containing no electrical wiring or other services, are easily movable and provide excellent flexibility in case of necessary changes in space distribution and utilization. Except in certain locations when special material is required, the floor is finished in terrazo in the halls; the concrete floor in the laboratories is specially treated with a hardener for ease in upkeep and to prevent dust formation. Sound-absorbing tile floor covering is provided in the lecture rooms, the library and administration offices. The structure is in reinforced concrete throughout, 4 ft. x 8 ft. veneer having been used on concrete forms to assure smoother finish on uncovered ceilings, columns and walls.

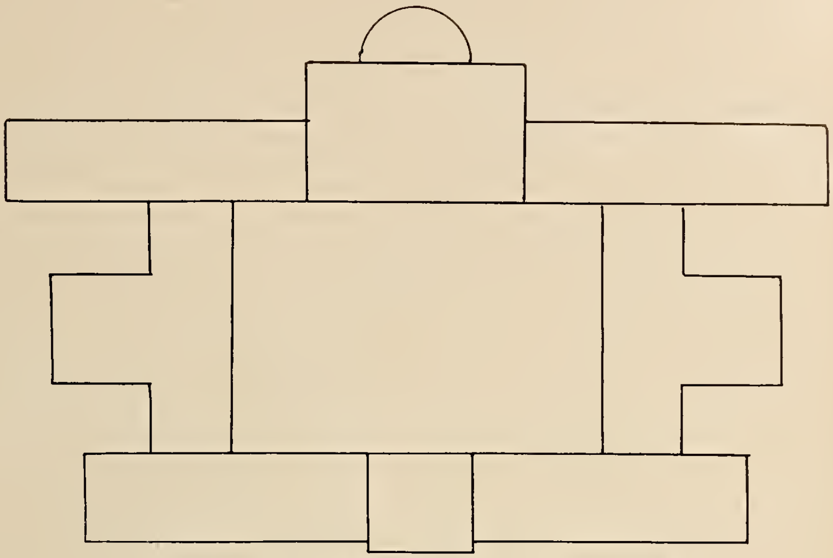
The foundation of the building is on rock of volcanic origin, unfortunately of inconsistent properties. Excavation for the laying of foundation required the removal of 125,000 cu. yd. of material, 60 per cent of which had to be blasted. About 25,000 cu. yd. of concrete have been poured to complete the structure. The building required 1,200,000 bricks and 500,000 blocks of various filling material. Stonework which lies at the bottom of the outside wall around the building covers an area of 24,000 sq. ft. The size of the roof is close to 115,000 sq. ft. and the building has 2,700 windows.

The team responsible to the board of governors for the execution of the project includes the following: the architect: Gaston Gagnier; the consulting engineers: Lalonde and Valois, for the reinforced concrete, P. P. Vinet, for heating, ventilation and other mechanical services, F. Leblanc, for the design of the electrical equipment, and the office of Lalonde, Girouard and Letendre, for the designs related to grounds, roads and accesses. The contract was let to Quemont Construction, owned by a Polytechnique graduate, Arthur Laplante. The resident engineer, supervising on behalf of Polytechnique is Roland Bureau, who will act as superintendent of buildings and grounds after the completion of the project.

The building is not designed for future extensions. It is estimated that 1,800 students will be very easily accommodated in it, which, based on the experience on the present site, probably means quite a few more. Whenever space becomes a problem again, it is estimated that the solution will lie in a separate building for one or more of the departments, thus allowing expansion of the remaining ones within the actual structure.

No one will dare to prophesy the future but, in view of present population estimates and trends in the orientation of the younger students in the high schools and classical colleges, it is expected that the enrolment of 1,800 will be reached very easily before the next ten years. It is felt in many quarters that this is still a conservative forecast.

The engineering profession is happy to see that this very important project is nearing completion. Engineering is becoming ever more popular among the students in the French high schools and classical colleges. The major industrial developments in Eastern Canada catch the eye and the mind of young French Canadians as they never did before. This, coupled with the normal increase in the school age population will soon result in a much greater participation of French Canada in national economic development. The new facilities of Ecole Polytechnique come at a good time to cater to the coming generation, which rightly sees the opportunities where they lie.



Plan of new building erected by Ecole Polytechnique.

The Journal Reports Growth in Engineering Faculties in Canada

This article is the first of a series intended to give an account of the physical development of the engineering faculties, so necessary to face the increase in enrolment and to supply industry with technical personnel.

Canadian Pipeline Projects

Alberta Gas Trunk Line

General manager J. K. Horton announced at end of October that in the event of Alberta and Southern obtaining necessary permits to export Alberta gas to California, the Alberta section of the line will be built and operated by Alberta Gas Trunk Line, subject to approval of the Minister of Mines and Minerals.

Canadian Western Natural Gas

Permission was granted early in December by the Alberta Government on recommendation of the Alberta Conservation Boards to Northwestern Utilities for a $3.5 million project to transport gas from the Pembina oil field to Edmonton. Alberta and Southern Gas Co. has contracted 80 per cent of all the gas in the Pembina area. The project involves a 72-mile pipeline and a gathering system.

Plans for a $9.5 million project to develop gas reserves in the Carbon area 55 miles northeast of Calgary as a source of winter peak day deliverability are announced by Vice-President B. F. Willson. Gas reserves of more than 200 billion cubic feet are to be acquired and additional wells will be drilled. A 16-inch pipeline ultimately capable of delivering 150 million cubic feet daily to the Calgary area will be built in 1958.

Trans Canada Pipelines

Seven spreads will go to work on the 1958 Trans Canada program for the 486 miles of 30-inch line from Kapuskasing to Toronto. Tenders are expected to close in December. Full winter operations are planned in clearing, brushing, and riprapping. Spreads will be as follows: No. 8 from Kapuskasing River 82 miles to Potter; No. 9 covers 83 miles, Potter to Kirkland Lake; No. 10 is 83 miles, Kirkland Lake to Rib Lake; Spread 11 is 47 miles, mostly in rock, Rib Lake to Tilden Lake; Spread 12 continues in rock and then in sand and clay 62 miles to South River; Spread 13 is 63 miles from South River to Bracebridge; Spread 14 covers 92 miles, Bracebridge to Maple, where the mainline feeds into the Niagara loop and the Toronto-Montreal line. Some deliveries of pipe had started by mid-November, and with adequate supplies of steel plate to mills, orders will be filled promptly.

All three spreads on the 20-inch Toronto-Montreal section of Trans Canada had welded out by the end of November. The line is being pigged and purged, with testing expected to be completed by mid-December. The dual 10,000-foot crossing of the Lake of Two Mountains above Oka was completed early in November. Trans Canada expects to be delivering gas to Montreal before the end of 1957, using a supply of borrowed gas from Union Gas Co. The 12-inch lateral to Ottawa is completed, as well as a lateral to Lindsay and purging and testing of both will be completed in December.

Northern Ontario Pipeline Crown Corporation

Work was still in progress at end of November on two spreads. Houston on spread D, ending at Port Arthur, welded and doped out early in November and at month end completed tie-ins and backfill. Dutton Williams on spread A, ending 3 miles east of Kenora, welded out and doped out on November 24 with final tie-ins expected before month-end. Morrison-Shivers on Spread B east of Vermilion Bay was still not finished with pipelaying but hoped to complete before winter shutdown. Majestic-Nelen Ltd. finished its rock ditch late in November and would weld and dope out before month end. Pigging, purging and testing will proceed in hopes of having gas at Lakehead before year-end. Crossing of the Winnipeg river at Kenora still remains a bottleneck and completion this year depends on weather, though delivery to Kenora appears possible.

Union Gas Co. of Canada

Welland Tubes Ltd. had completed its order for 20,000 lengths of big-inch steel pipe by the end of November. The pipe is being useful in the Company's 142-mile gas pipeline from Dawn Township to Hamilton and Streetsville.

Winnipeg & Central Gas Co.

Claims by the Winnipeg and Central Gas Co. that it has exclusive natural gas distribution rights in greater Winnipeg will be tested soon before the Municipal and Public Utility Board. The board will be asked by the suburb of St. James to confirm a franchise granted to a competitive company by St. James city council. If this franchise is confirmed it would mean Great Northern Gas Utilities Limited had made a good bid to move into the Winnipeg market. Offering lower consumer rates than Winnipeg and Central, Great Northern would pick up a number of other suburban franchises.

A third bid for the market has been made by Great Plains Gas Co., offering a rate of 71 cents per thousand feet compared with 81 cents offered by Great Northern and $1.03 by Winnipeg and Central.

Qubec Natural Gas Corporation

The $6 million natural gas conversion program will begin in Montreal in January 1958 when gas is scheduled to be available. The cost will be amortized over 12½ years. Conversion is slated to take 20 weeks and to employ some 500 men. Involved are gas appliances for almost 250,000 customers.

President Maurice Forget stated in late November that the conversion would be followed by a longer range plan to extend lines into areas not now served, at a possible cost of $30 million. Natural gas will be available on a loan basis from Union Gas.

Sales of manufactured gas in 1951, as revealed by the last census of housing, revealed that cooking was by gas in 185,000 of Montreal's 246,000 households. Sales of manufactured gas in 1956 by Hydro Quebec were 8½ billion cubic feet. This was 465 B.t.u. gas. Converting it to natural gas leaves volume at about four billion cubic feet. With the expansion now planned Forget expects total by 1962 to amount to 40 billion cubic feet yearly, a ten-fold increase. Of this, residential use may account for 12 billion, while large industrial use may amount to another 24 billion feet in firm and interruptible services.

U.S. Demands Action Soon on Gas Issue

Federal Power Commission Examiner Francis Hall, hearing the Tennessee Midwestern case at Washington, dismissed a motion early in Deceber to kill the hearings made on the grounds that appointment of Canada's Royal Commission (The Borden Commission) on Energy indicates a lengthy delay at best before export premission can be given by the Diefenbaker government. He warned that "failure of Canadian Authorities to act timely and definitively may very well cause the FPC to consider that the Midwestern and Tennessee applications have reached the end of the road". He noted, however, that the Diefenbaker government had not specifically rejected a promise of an export license made by former Trade and Commerce Minister C. D. Howe.

With many searching questions arising in Parliament in the wake of the recent Diefenbaker announcement on gas policy, key Canadian gas authorities are making strong recommendations. The main one is that the Borden Commission be required to swing its investigation onto the gas phase of its study at once, and come up with as early an interim recommendation on gas export as possible.

Indignation at the long delay in natural gas development imposed by Ottawa's declaration on export permits has erupted in the form of public statements by three leading oil and pipeline executives. They all covered the same theme: that natural gas in Western Canada is in surplus supply, that export is the only solution, and that idle capital invested in capped gas reserves is a strong deterrent to further exploration and development. But the surplus problem must be impressed on governments as well as being told to public audiences.

Dominion Bridge Anniversary

The Dominion Bridge Company on November 20 celebrated the 75th anniversary of its founding in 1882 at Lachine, Quebec. The company is now engaged in a $20 million expansion program designed to increase its capacity by 40 per cent in 1960.

Since 1883, when the first plant was built with a production capacity of 1,000 tons of finished steel per month, the company has grown to one of 9,000 employees and 7,779 shareholders with 14 plants across the country.

Typical of the development of Canada is the changing nature of the work undertaken by this completely Canadian company. In 1900, for example, 90 per cent of its work was in the building of bridges. Today, bridge construction represents a comparatively small proportion of the annual output. In addition to supplying the steel framework for structures of all kinds, the company designs and builds gate equipment for hydro-electric power developments, cranes and other handling equipment; huge vessels and other equipment for the pulp and paper, chemical, oil and mining industries, and a wide range of boilers. It also operates eleven steel warehouses and steel mill.

The national scope of this company is illustrated by the Lion's Gate Bridge in Vancouver, and the Angus L. MacDonald Bridge in Halifax; by the Sun Life Building in Montreal, the Chateau Laurier in Ottawa, the Royal York in Toronto, and the new Winnipeg Post Office, for all of which Dominion Bridge supplied and erected the steelwork. Today there are many all-welded buildings and bridges in Canada testifying to the Company's pioneer development of electric arc welding and other aspects of steel fabrication.

Three New Branch Railways

Three branch railways were completed in 1957 and are being operated by CNR into mining areas in New Brunswick, Quebec and Manitoba.

Beattyville-Chibougamau

The 161-mile CNR line from Beattyville to Chibougamau, recently completed, is part of a larger project to serve the 300 square miles of the Chibougamau area in Northern Quebec.

The completed railway, branching from the C.N.R.'s northern transcontinental line, will be 294 miles long terminating at St. Felicien in the Lake St. John area. The St. Felicien-Chibougamau section is now under construction.

The route, planned in 1953, crosses bushland, muskeg, forest, and a number of fast-flowing rivers. Construction began in November 1954.

By the fall of 1955 the line had been almost completely cleared, with grading well advanced. Work on bridges was well ahead, and the major construction problem of spanning the Bell River had been overcome. Here the first cantilever structure ever built by C.N.R. engineers was constructed. There are ten bridges on the line.

In March 1957, ore was first carried over the completed line to the Noranda smelter, but consolidation was necessary at spring break-up. Ballast lifts were used to remedy frost action and settlement in muskeg areas.

The line was inspected and approved for freight and passenger traffic in October 1957. General supervision of construction was in the hands of the chief engineer of CNR's central region, W. E. Griffiths. Construction work in the field was supervised by the chief engineer of construction, central region, G. H. Workman, and was the direct responsibility of the regional construction engineer, R. E. Oldham. The bridges were designed by the system bridge engineer, T. H. Jenkins, M.E.I.C., and their construction was supervised by the regional bridge engineer, E. J. Napier.

Heath Steele-Bartibog

In 1955 Heath Steele Mines Limited started construction of a concentrating mill to commence development of major base metal deposits in northwestern New Brunswick, and entered into negotiations with Canadian National Railways, who agreed to construct a railway to serve the area.

Survey parties began working in February 1956 on the line, 22.9 miles from Bartibog to the Heath Steele property. They were aided by aerial photographs and maps furnished by the New Brunswick government. Swamp land, heavily forested flat land, a number of deep ravines and broken, rocky ground were encountered in the relatively short distance.

Construction of the sub-grade was undertaken by Modern Construction Co. Ltd., Moncton, in September 1956.

Tractors and earth moving machinery cut through 325 acres of forest. Bulldozers, scrapers, shovels and carryalls moved 22 million cubic feet of rock and earth to form out the roadbed. Twenty-seven million feet of earth were excavated to make the cuts. Many of the cuts were blasted through igneous rock, and some of them are 50 feet in height.

The Little Tomogonops River was diverted to flow through two 12-feet diameter pipes, 200 feet long. Above the pipes, a gorge 60 feet high and 300 feet wide was filled with 500,000 cubic yards of earth, topped with special ballast, to form the roadbed at this location.

In charge of the work in its various phases were D. W. Blair, M.E.I.C., regional chief engineer, R. K. Delong, engineer of construction, and M. J. Nickerson, JR.E.I.C., resident engineer of Canadian National Railways.

Sipiwesk-Moak Lake

Operations began in October 1957 over a 32-mile line from Sipiwesk on the Hudson Bay Railway to the International Nickel Company's base metal development at Moak Lake, Manitoba. The line was built by INCO, and is being operated by the Canadian National Railways.

● **DISCUSSION** *(continued from page 79)*

BATTLE RIVER STEAM STATION: *The Engineering Journal*, January 1958.

The Saskatchewan Power Corporation recently completed a series of tests with Drumheller and Saskatchewan lignite coal on a boiler at the A.L. Cole Station, Saskatoon, similar to the one Mr. Ford has just described.

This boiler and fuel firing equipment were not designed for lignite and it was therefore expected that the capacity would be limited because of the lower heating value and higher moisture content of this fuel. The maximum load attainable on lignite was about two-thirds of boiler rating and surprisingly, this limit was imposed because of high steam temperature and not because of difficulties with the fuel firing equipment. There was, however, some difficulty with plugging of the dust collector.

The most striking result of the test was the effect of lignite coal on the performance of the superheater. At a steam flow of 225,000 pounds per hour the temperature rise of the steam through the convection super-heater was 315° F on lignite and only 250° F on Drumheller. This higher steam temperature on lignite occurred in spite of the fact that the tangential burners were tilted down from the horizontal 25° on lignite and only 5° on Drumheller. Although there is a higher mass flow through the boiler on lignite this does not completely explain the higher rate of heat transfer to the convection superheater and no complete and satisfactory explanation for this difference has yet been proposed.

It is planned in the near future to run a similar set of tests on this boiler with Forestburg and Wabamun coal and the results of all of these tests will be reported to the industry in due course.

Canadian Utilities Limited are to be complimented on their pioneering installation at Drumheller which was the first modern pulverized fuel plant in Western Canada. Much valuable information has been gained from experimentation and test on this installation which has been very valuable to other utilities planning to burn Drumheller coal.

I understand that in preparation for the design of the Battle River boiler, Canadian Utilities ran a series of tests on their Drumheller installations with Forestburg coal. I would like to ask Mr. Ford to comment briefly on the differences they discovered between the pulverizing and burning characteristics of Forestburg and Drumheller coal and also if the results attained in the tangentially fired unit at Battle River have been in line with expectations resulting from tests on the horizontally fired units at Drumheller.

The Author

In reply to Mr. Campbell's question, the tests made with the Forestburg coal at our Drumheller plant were made to study its pulverizing characteristics rather than how it burned. Our pulverizers at the Forestburg plant operated satisfactorily when the primary air temperature required for drying was correct.

I quite agree with Mr. Campbell that Western Canadian coals should be analysed very carefully as to burning characteristics, even though they may be similar in every other respect, when a thermal plant is being planned.

Southern Ontario Regional Conference

15 March, 1958

Royal Connaught Hotel, Hamilton, Ontario

Participating Branches

Border Cities Hamilton Kitchener London
Niagara Peninsula Sarnia Toronto

The Program Will Include

Noon Luncheon Reception and Cocktails
Technical Papers Dinner and Guest Speaker
Dance (dress optional)
***For the Ladies:* Special noon luncheon and afternoon program**

FURTHER DETAILS WILL BE GIVEN IN THE FEBRUARY ISSUE

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

The 49th Branch

At Baie Comeau, Que., on the night of Friday, December 6, President Anson officially inaugurated another branch of the Institute, the occasion being marked by the presentation of the charter at a large gathering of citizens of that Lower St. Lawrence industrial centre.

Canada's steady march toward geographic and industrial expansion is shown very markedly in this area. For many years Baie Comeau has been famous as a paper town, but within the last two years new industry has sprung up there to increase greatly the social and industrial activity. The Canadian British Aluminum Company Limited is the giant newcomer which has gone out into rough new terrain to set up industrial buildings, roads, services and town sites, to transform the area from rock and forest into a new self supporting municipality. Naturally such a development would bring to this distant shore a host of engineers and other technical personnel. Fifty-one persons signed the petition for a charter.

For the Institute to establish a branch there is to follow the long established policy of going forward with the frontiers of industrial expansion. Branches in Newfoundland, at Seven Islands further down the St. Lawrence, and at Whitehorse in the Yukon, are further examples of the Institute's policy of advancing with the profession and with Canada.

V. M. Wallingford is Chairman

The first chairman of the new branch is V. M. Wallingford of the Canadian British Aluminum Company, and to him must go much of the credit for the new unit within the E.I.C. He has been a member of the Institute since 1944, but most of this time has been spent at centres where there was no branch. The other officers of the branch are:

Secretary, Norman Lapierre; Treasurer, T. G. Rust; Executive Committee, Peter Suttie, G. Scott and J. M. Pope.

The inaugural function was in the form of a banquet at the delightful Manoir Comeau. There were 115 in attendance. The mayor of Baie Comeau, J. A. Duchesneau, welcomed the visitors and expressed his satisfaction in seeing an engineering society established within the community. The president was accompanied by Mrs. Anson, past vice-president R. L. Dunsmore and the general secretary.

Greetings from Other Branches

B. M. Monaghan, chairman of the branch at Seven Islands, was present to wish the new branch success, and to make a presentation to the new chairman on behalf of his, the parent, branch.

The banquet was followed by a dance which provided a happy conclusion to an important and pleasant development in local affairs.

The presidential party was shown over the territory and was duly impressed. The C.B.A. Company have done a remarkable piece of work in building a town and a plant in about a year and a half. Current was turned on in one row of pots, for the first time, on Saturday, December 7. This was not an official opening, but it was even more important, for it was a real test of the equipment, the materials and the engineering — and it was successful. Arrangements have been made for a paper on the plant to be presented to the Institute.

It was surprising to see the great expansion in and around Baie Comeau. The new town for C.B.A.—Baie Comeau Nord—and the new town of Hautrive, along with the original Baie Comeau, are expected to have 25,000 people by 1965. That is a measure of Canada's expansion, in all of which the Institute is privileged to participate.

The Angus Medal

The Robert W. Angus Medal will be awarded by the Engineering Institute for the best paper each year on a mechanical engineering subject, the first award to be made at the 1958 annual meeting in Quebec.

The medal is so named to honour the achievements of Robert W. Angus, HON. M.E.I.C., emeritus professor of mechanical engineering at the University of Toronto. Professor Angus, now in his 84th year, is residing in Toronto after a long and distinguished career.

The Council of the Institute will administer the award, which has been made possible through the generosity of two members of the Institute, brothers, H. G. Thompson of Brockville, and W. L. Thompson, of Toronto. They are both mechanical engineers, and both former pupils of Professor Angus. There is also another bond — Prof. Angus and the Thompsons spent their school days in London, Ontario.

The conditions of the award of the Angus Medal, as they appear below, provide that there will now be a means of acknowledging the best Canadian contributions to the literature of mechanical engineering. That this event should be associated with the name of the well known Toronto professor will be thought appropriate by a great number of engineers and particularly by former University of

NOTE: Please let the Editor know if you did not receive your regular *Journal* in December, a copy will then be sent to you.

Toronto students.

Professor Angus received his primary education in London, Ontario, and later completed his academic training with a B.A.Sc. degree from the University of Toronto in 1896. He was engaged in the establishment of mechanical engineering as a separate department of that university, became its lecturer in 1900 and its first professor in 1906. He retained this position until he retired in 1944.

Always conscious of the liaison that must be maintained between class room and industry, Robert Angus devoted much of his life to consulting work. The most recent consulting job was the design of a 15 mgd. filtration plant for New Toronto, finished in 1953.

His work has been recognized by the distinction of election to Honorary Membership in the Engineering Institute of Canada in 1937, in the American Society of Mechanical Engineers in 1940, and in the American Water Works Association in 1945. He is also a member of the Institution of Mechanical Engineers. He was active in promoting the Association of Professional Engineers of Ontario, and was its president in 1936.

Professor Angus is the author of numerous papers and articles, and has made a definite contribution to the literature on water hammer, on which subject he has also done considerable consulting work.

Conditions of the Award

1. Competition for the medal shall be open to any corporate member of The Engineering Institute of Canada, The Institution of Mechanical Engineers or The American Society of Mechanical Engineers, who is resident in Canada at the time the paper is presented.

2. Award shall be made not oftener than once a year, and the medal year shall be the year ended June last previous to the year in which the award is made.

3. The medal shall be presented at annual meetings of the Engineering Institute of Canada.

4. A committee of five shall judge the papers entered for competition, all of whom shall be members of The Engineering Institute of Canada, and shall be appointed by the Council of the Institute.

5. All papers presented shall be the work of the author and shall have been presented at a meeting of The Engineering Institute of Canada as well as published in the literature of the society. To be eligible no paper shall have been made public previously or contributed to any other society in whole or in part prior to its presentation before a meeting of The Engineering Institute of Canada.

6. In the event of the committee not considering a paper in any one year of sufficient merit, no award shall be made; but in the following year or years, it shall be in the power of the committee to award the accumulated medals to the authors of different papers which may be deemed of sufficient merit.

Nominees for Office

A list of nominees for office, as reported by the Nominating Committee, appeared on Page 1492 of the October, 1957, issue of the *Journal*. Since that time the committee has reported the selection for president as follows:

President . . . . Kenneth Franklin Tupper . . . . Toronto, Ont.

This Journal is Different

There are a number of improvements and new features in the January issue.

These added services are largely the result of the Publication Committee and the staff considering the many valuable suggestions received from readers in response to the Reader Survey which has been conducted every month during the past year.

Some of the measures adopted will enable the *Journal* to be even more complete in its editorial coverage, while others will facilitate reference to the *Journal* or will put into effect improvements in publishing practice. They should result in convenience, simplicity, and more varied and improved editorial material.

- The pages of each issue of the 1958 volume will be numbered consecutively from the first to the last page, each issue commencing on Page 1. The two sets of numbers distinguishing editorial and advertising pages will be discontinued.
- The number of each issue (1 to 12) will be prominently shown on the spine of the book.
- The Contents Page will be Page 3 in every issue. This will be good news for the many readers requesting this change. The Contents Page has also been redesigned.
- The new Page 5, "Meet the Authors" is an innovation—a page devoted to notes on the people who contribute papers. This page also includes the "Cover Picture" description.
- There is a new "International Section" in which technological developments in other countries of interest to Canadian engineers will be reviewed. One country at a time will be featured, commencing with the U.S.S.R. in this issue.
- A timely series describing expansion of teaching facilities for the engineering faculties at the Canadian universities also begins this month.
- An item of briefs, "Did You Know?" in the Month to Month Section, may help to recall some facts about the accomplishments and operation of The Engineering Institute.

President and Mrs. C. M. Anson visited Sherbrooke on November 25. This picture taken at a Branch meeting shows, left to right, Mrs. Gaetan Cote, Mrs. George Cote, Mrs. Mawhood, Mrs. Dick, Mrs. Dunsmore, Mrs. Anson, Mrs. Masse; George Cote, R. L. Dunsmore, Gaetan Cote, L. Austin Wright, Mr. Anson, Branch Chairman R. D. Mawhood, Vice-President G. M. Dick, Jacques Lemieux, Gaston Masse.

THIRTY-FIVE YEARS AGO

Comment on the Journal of January, 1923

Almost half of the January 1923 issue was devoted to publication of three papers: Electric Furnaces For Heat Treatment of Steel, by A. W. Lamont, A.M.E.I.C., of Canadian Westinghouse Co. Ltd.; Power Factor, Its Physical Meaning and Commercial Application, by W. G. H. Cam, E.E., A.M.E,I.C., of the Canada Cement Co. Ltd.; and The Inspection of Ferrous Materials, by E. A. Allcut, Associate Professor of Thermodynamics, University of Toronto. These papers, particularly the one on Power Factor, are valuable papers for the young engineers.

A dozen pages were devoted to Branch News. The London Branch recorded an address on Town Planning and proposed legislation in relation to it, presented by J. Clark Keith, A.M.E.I.C., secretary-treasurer of the Border Cities Branch, who pointed out town planning was 'a firm base for building a healthy, happy community.

The Fuel Situation was the subject of a symposium, in Ottawa with interesting addresses by B. F. Haanel, M.E.I.C., of the Department of Mines; G. Gordon Gale, M.E.I.C., of Hull Electric; George Mountain, M.E.I.C., chief engineer of the Railway Commission, and Hon. D. D. MacKenzie, solicitor general. Dr. Charles Camsell, deputy minister of mines, reviewed the coal situation.

The Kingston Branch recorded a discussion on Meteorology and Weather Forecasting, including an address on the subject by Dr. A. L. Clark, HON. M.E.I.C., dean of the Faculty of Science, Queen's University. Captain Donnelly presented a paper at another meeting on the releasing of the steamer *Rapids Prince* from the rocks of the Lachine Rapids in the St. Lawrence River,

Members of the Hamilton Branch welcomed Professor Lester Willis Gill, M.E.I.C., recently appointed principal of the new technical school at Hamilton, who had served during World War I as director of education for the Khaki College under Colonel Tory On his return from overseas, Prof. Gill had been given the office of director of technical education for the Dominion Government.

A number of interesting papers and addresses were reported by the Winnipeg Branch for December 1922, subjects being Relativity; An Electric Furnace for Heat Treatment of Moving Parts of C.N.R. Locomotives; The Economics of Rate Making as Applied to a Public Utility; and a report by Harold Edwards, A.M.E.I.C., on behalf of the Committee on Foundations.

The Niagara Branch reported on an inspection trip over the Niagara Falls Power Company's plant at Niagara Falls, N.Y., and the intake works of the Queenston Chippawa power development, which was followed by a dinner at the Clifton Inn and an address on the Near East by Mr. D. A. Andrus.

November meetings of the Saskatchewan Branch had been devoted to addresses and discussions of The Clay Products of Saskatchewan; and Town Planning in its Relation to the Engineering Profession.

The Vancouver Branch reported on its November general meeting, at the new auditorium of the Vancouver Board of Trade. An innovation had been the introduction of a speaker outside of the Engineering Profession, Dr. R. H. Mullin, director of laboratories, Vancouver General Hospital, whose subject was Sanitary Water Supplies.

The Toronto Branch reported well attended weekly meetings during November, one of which was taken up with discussion of the report of the Committee on Policy, as formulated at the meeting at Montreal in April 11, 1922. Addresses at other meetings included one by R. C. Harris, commissioner of works, City of Toronto, on The Local Improvement Act; Purification of Public Water Supplies, by Norman J. Howard, chemist and bacteriologist at the Toronto Filtration Plant; and a discussion of the Institute's Report of the Committee on Classification and Remuneration.

In the Maritimes, Dr. Bigelow, dean of the Faculty of Science, Mount Allison, addressed the Moncton Branch on The Place of Research in the Development of Canadian Industries. The annual meeting of the Cape Breton Branch was addressed by J. G. H. Purves, M.E.I.C., on the subject of Abnormal Friction Losses in a 12-inch Water Main. At the monthly meeting for December the Saint John Branch heard a paper entitled A Fundamental Plant Study of Saint John by W. R. Pearce, M.E.I.C., chief Engineer, New Brunswick Telephone Company. Members of the Halifax Branch heard J. A. Wilson, A.M.E.I.C., secretary of the Dominion Air Board, on the subject of Aviation in Canada.

James Watt International Medal

The Council of the Institution of Mechanical Engineers, London, issued last fall the brochure containing a record of the proceedings in May 1957 of the presentation of the James Watt International Medal to Professor Dr. Ing. Walther Bauersfeld, of Germany.

The award was made in recognition of Professor Bauersfeld's great work as a scientist, as an inventor and as a successful organizer, particularly in the application of precision engineering in the field of optics.

Sir Ewart Smith, vice-president, made the citation, summarized below:

Walther Bauersfeld was born in Berlin in 1879, and studied mechanical engineering at the Technische Hoshschule, Berlin-Charlottenburg. He worked as an assistant to the professor of mechanical engineering and hydraulic prime movers from 1903 to 1905. In the latter year he joined the firm of Carl Zeiss, Jena, as design engineer, and has served continuously with this organization up to the present time.

Throughout this long industrial career, he has maintained a close interest in technological education.

Walther Bauersfeld has had a profound influence on many branches of engineering as a result of his scientific work, technical inventions, and practical design. These include major improvements to water turbines of the Kaplan type. He has contributed to the developments of gearing, of sliding ball bearings, and of precision bearings having minimal friction. He invented the Phantophos lamp and has been responsible for many inventions in the field of ancillary lens systems, projection and stereophotographic plotting. He has also done much to improve the mechanical development of the microscope. He has also been largely responsible for the development and design of the modern projection planetarium.

As an industrial organizer and leader, he has further developed the pioneering work of Professor Ernst Abbe, who founded the Zeiss Trust in 1896.

As chairman of the Foundation, Dr. Bauersfeld rebuilt the Zeiss organization in Western Germany (the works at Jena had been dismantled by the Russians in 1946). At Stuttgart he collected the nucleus of key staff and skilled workmen from Jena, believing that it is people, and not equipment, who are crucial in any undertaking. By 1951, the Zeiss-Werke was again established.

Did You Know That . . .

The Engineering Institute has co-operative agreements with eighteen societies, including the American Society of Mechanical Engineers, The American Society of Civil Engineers, and the leading institutions throughout the British Commonwealth.

Elections and Transfers

A number of applications were presented for consideration and on the recommendation of the Admissions Committee, the following elections and transfers were effected at a meeting of council held at Saint John, N.B., on November 23, 1957.

Members: A. H. C. Carson, Baie Comeau; J. C. Cherna, Montreal; T. M. Claughton, Montreal; D. C. Cullingham, Temiskaming; L. E. Fischer, Seven Islands; R. Folli, St. Johns; G. M. Goodreid, North Bay; R. W. Griffiths, Hamilton; D. L. Halsall, Seneca Falls, N.Y.; T. Henry, Calgary; N. Holloway, Montreal; E. Holzl, Montreal; E. C. Hopkinson, Tulsa, Okla.; H. R. Jenkins, Baie Comeau, Quebec; E. J. Kane, Quebec; B. A. Kelly, Baie Comeau; R. W. Kirkland, Seven Islands; A. R. G. Leckie, Calgary; V. S. G. Lewis, Kingston; J. A. Little, Seven Islands; Y. Liu, Toronto; R. L. MacIntosh, Quebec; D. W. R. McKinley, Ottawa; C. E. McManus, Montreal; L. A. Madonna, Ottawa; W. S. Martin, Seven Islands; J. Negro-Morel, Baie Comeau; C. J. B. Newton, Montreal; J. L. Nyke, Montreal; J. T. Power, Thicket Portage; C. M. Rodkiewicz, Toronto; T. G. Rust, Baie Comeau; M. R. Scriven, Montreal; J. N. Seguire, Shawinigan South; S. I. Simon, Montreal; K. Tammik, Montreal; W. M. Taylor, Montreal; J. B. Tee, Dundas; R. A. Temple, Toronto; G. Trepanier, Baie Comeau; W. W. Walker, Toronto; W. G. Ward, Peterborough; A. G. White, St. Catharines.

Juniors: W. E. Desbarats, Montreal; F. E. Estabrook, Calgary; D. G. Hubley, St. John's; J. A. Karnas, Montreal; S. S. Kathuria, Hamilton; G. Kepes, Arvida; L. H. Lafontaine, Montreal; J. A. G. McGurhill, Ottawa; L. A. Quinn, Isle Maligne; R. G. T. Wilson, Baie Comeau.

Junior to Member: W. F. Allen, Edmonton; J. B. Bowron, Calgary; F. S. R. Flewelling, St. Catharines; F. L. Kahn, Toronto; H. T. Kane, Quebec; J. A. Kane, Quebec; E. O. LaFontaine, Windsor; E. Maltz, Regina; H. Reicher, Toronto; C. H. Smith, Calgary; C. M. Williams, Grand'Mere; B. E. Wilson, Toronto; L. A. Zalkind, Toronto.

Student to Junior: H. A. Dalkie, Winnipeg.

Affiliate: C. F. Baxter, Copper Cliff; R. Betley, Brockville.

STUDENTS ADMITTED:

University of New Brunswick: A. M. Adams, K. F. Agnew, L. S. Armstrong, G. A. Arseneault, B. B. Barnes, L. J. Barrett, W. F. Barrett, E. M. Barrie, J. A. P. Belyea, D. B. Betts, W. Bodzian, J. L. J. Bourque, H. Breau, T. W. Bremner, C. J. Brideau, R. M. Broley, D. J. Burden, R. J. Burden, F. D. Campbell, G. G. Carson, C. T. Cheeseman, F. H. Christensen, D. C. Clark, F. R. W. Clarke, W. S. Collins, V. E. Colpitts, D. F. Colwell, P. R. Comeau, R. E. Cowan, N. A. Coy, W. A. Davis, K. W. Demmings, G. J. de Montigny, R. T. Dickie, Jr., R. L. Dieffenthaller, J. Dube, D. D. Ferguson, K. M. Ferguson, R. B. Ford, C. T. French, G. W. Givens, G. E. Gunter, R. E. Haggerty, J. D. Harries, A. G. Heal, A. Y. Y. Ho, W. N. Horner, R. L. Houde;
H. D. Johnston, P. Katsos, M. G. Kingsmill, L. A. Kingston, D. L. Knox, I. C. Laurie, G. R. Lavoie, R. J. Lynch, J. S. MacLean, W. C. MacLean, A. R. MacLellan, M. E. MacTavish, C. V. Marston, E. A. McCavour, F. W. McEwen, C. W. B. McFarlane, J. R. McFarlane, J. I. McLeod, J. B. Meredith, A. N. Mitton, A. E. More, M. T. S. Moriarity, J. C. Mulholland, W. J. Oudermans, D. Parada, C. A. Parker, W. C. Perry, G. A. Phinney, R. T. Pickett, G. M. Price, C. B. Prosser, A. J. Richard, D. W. Ripley, J. R. Robinson, C. D. Roushorn, S. A. Russell, W. C. Sargent, J. H. Saunders, G. E. Scott, I. N. Scrimgeour, J. P. Sears, B. O. S. Small, M. A. Stairs, R. A. Sullivan, G. L. Titus, V. G. Tracey, G. B. Turnbull, T. R. Underhill, D. A. Vallis, N. H. Wade, O. V. Washburn, R. M. Whitehead, H. S. Wiliams, J. C. Wilson, D. F. Wright, S. L. Wright.

University of British Columbia: R. Addison, A. B. Ages, L. A. Bell, A. Berzins, S. S. Brar, B. F. Brown, M. P. Brown, H. G. A. Copping, W. H. Carey, R. K. Craigie, E. L. Creelman, J. R. Dacy, B. DeBruyn, W. D. Diment, R. G. Doyle, H. E. Fandrich, J. S. Ford, D. R. Forrest, A. G. Fowler, D. E. Frisby, W. D. Gill, W. A. G. Gough, D. A. Graham, D. F. Hadwin, J. E. Hahn, P. L. Hahn, N. E. Haimila, B. H. Heyd, D. G. Hilderbrand, P. R. Hill, P. J. Horkko, P. J. A. Hunter, D. F. Irving, W. R. Janzsen, D. A. R. Jones, D. C. King.
A. M. Lawson, R. M. Lindsay, T. Lynum, R. A. Macalister, C. J. Macfarlane, M. A. McAndrew, D. R. McDiarmid, A. N. McLennan, K. A. Minielly, A. J. Montador, B. Moras, B. Nagai, E. G. Nixon, R. Noble, D. J. Panton, W. E. Parker, B. A. Pavlov-Tseplieff, L. C. Peterson, P. D. Plunkett, A. G. Pullman, H. J. Rainer, R. D. Rantz, I. S. Riar, C. M. Robson, R. S. Roger, D. J. Rose, G. S. Sangra, W. W. Schilling, H. A. Semturis, V. Singh, D. Stanyer, R. N. Stone, R. A. Strachan;
G. Tateishi, D. E. Taylor, D. C. Thom, K. W. Turnbull, R. H. Waddy, J. D. Walsh, J. T. Walton, G. H. Wearne, G. O. Wilkie, K. C. Wilson, E. Wong, W. Worobey.

University of Alberta: W. Babowal, R. B. Dryburgh, W. N. Hasegawa, E. G. Lang, J. F. Leman, W. Long, D. E. Longley, R. E. Loov, A. C. Payne, M. Pich, C. E. F. Schroder, G. G. Stotts, J. H. Tymchuk, R. J. Watson, L. J. Woznow.

Nova Scotia Technical College: G. H. Atwood, E. T. Bonn, R. C. Brawn, L. A. Buckler, D. M. Campbell, J. W. Carey, A. M. Crooks, G. J. Cullinan, C. G. Dewey, L. Dion, L. S. Fisher, J. D. Fitch, J. Freeman-Marsh, F. D. Gallagher, R. C. Godin, J. W. Gosnell, J. C. Grant, A. A. Grecoff, J. H. Guild, R. E. C. Haack, R. G. Hanes, J. Jay, D. D. Johnston, H. T. Joseph;
G. W. Keays, D. R. Kell, J. F. P. Kennedy, H. R. Kerr, D. G. Laing, A. J. MacDonald, D. A. MacKenzie, L. J. Mason, J. W. McDavid, P. D. Murphy, G. L. Noel, R. H. O'Brien, S. S. Pefhany, R. P. Richard, J. B. Riordan, S. Sarsito, V. L. Saxon, R. S. I. Sedijono, H. B. Severance, C. J. Smith, W. A. Sullivan, G. K. Thompson, A. H. Tinmouth, H. N. Vandenakker, J. A. Wallington, D. B. Warner, R. N. Wentzell, M. S. Wirjoprodjo.

University of Western Ontario: V. Awdeychuk, E. M. Aziz, N. J. Baertsoen, H. M. Baxter, J. S. Bedggood, K. P. Bellis, R. R. Britney, C. E. Corless, R. K. Cross, I. C. Dickson, D. R. C. Durnford, R. E. Durnin, R. J. Elford, K. Fletzer, J. R. E. Frank, W. B. Hewat, N. Isyumov, R. L. Judd, J. M. Kilpatrick, D. S. Lecoq, J. A. Leeson, G. Liepins, B. E. Maxfield, L. H. McGill, J. G McLarty, F. W. Midwood;
K. E. Newton, D. D. Partlo, J. F. Pleva, R. G. Robotham, J. W. Shephard, J. M. Trenouth, G. K. Vanslyke, R. M. Whitcombe, W. N. Willis.

Royal Military College: C. J. Barrigar, P. J. G. R. Bedard, J. Brodeur, L. C. Brown, T. M. Chell, S. C. Dunbar, R. J. Evraire, G. G. Facey, P. J. Harkness, G. W. Hosang, W. G. Johnson, G. P. Joyce, C. J. Kurtz, G. D. Leslie, J. L. MacDougall, A. J. K. McKinnon, P. B. Montpetit, W. A. Morrison;
J. J. Oakes, R. J. Rennie, L. P. R. Rousseau, G. D. Simpson, W. Slipchenko, H. J. Stein, M. L. Taylor, M. D. Thom, J. R. Toye, F. R. Walton, D. A. Whiffin, R. W. Whitehead, G. F. Williamson, A. R. H. Wood.

University of Toronto: J. Armstrong, D. W. Bacon, D. R. L. Bannister, N. D. Bowen, J. B. Dale, A. A. Douloff, E. T. Faragher, P. Feldman, T. P. Forgacs, R. A. Froebel, D. J. Gilpin, D. E. Hewson, P. M. Higgins, W. L. C. Knowles, H. W. Kriss;
L. M. R. Legrow, B. H. E. Maynard, J. D. Moorhouse, D. M. Pameter, R. N. Patterson, W. G. Pearce, B. S. Phillips, S. Rosenberg, J. B. Sutherland, J. A. Toms, G. C. Toye, P. D. Wallace, W. Zachernuk.

Carleton University: N. E. Anderson, S. B. Boucher, J. S. Buchan, B. Colby, A. R. Elliott, J. I. Hanson, H. R. E. Hoare, J. T. R. Jackson, R. H. Jones, P. E. Kelly, J. V. Kennedy;
S. A. McLauchlan, I. K. Mitchell, B. C. Morgan, M. Pastien, G. Pitsicoulis, C. A. Rockburne, D. W. Sparks, F. W. Thomas, T. C. Waldie, D. N. Wray.

University of Saskatchewan: L. R. Bullock, D. R. Bundy, M. J. Chorel, R. E. Godin, W. A. Hinz, R. L. Holm, C. D. Hopkins, A. M. Lepine, M. J. Lepine, A. G. Weimer, A. Werner.

Dalhousie University: V. D. Conrad, F. Cordeau, D. M. Lewis, W. A. Massey, R. B. McIsaac.

Acadia University: D. G. Killen, D. Reardon, R. B. Rogers, D. R. Smith.

Queen's University: W. G. B. Armstrong, J. E. Gaylord, H. P. Russell, R. J. Salvas.

Mount Allison University: N. F. MacLeod, D. A. Roy.

McGill University: B. R. Walsh.

University of Manitoba: I. Shore.
Sir George Williams College: A. H. Kursell.

University of Sherbrooke: J. B. Hamel.

Imperial College: B. W. D. Sarjeant.

University College: M. S. Cunningham.

C.P.E.Q. Students: J. S. Crispin, R. M. Gifford, D. V. Doran-Veevers.

A.P.E.Ont. Student: F. G. J. Legros.

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members: F. Blackburn, W. D. Storey, A. E. Van Clieaf, N. W. Polak; **Junior:** F. K. Szojka.

SASKATCHEWAN

Member: G. W. Moore; **Junior to Member:** J. L. Labossiere.

NOVA SCOTIA

Junior to Member: D. F. Oakley, J. V. Palmer.

NEW BRUNSWICK

Member: H. Knell; **Junior to Member:** R. E. Haines.

QUEBEC

Member: R. G. Fuller.

THE ENGINEERING INSTITUTE OF CANADA

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†R. E. Heartz, Montreal
‡V. A. McKillop, London

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†A. Deschamps, Montreal, Que.
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*G. M. Dick, Sherbrooke, Que.
†W. J. Ripley, Sudbury, Ont.
*H. W. L. Doane, Halifax, N.S.
*H. R. Sills, Peterborough, Ont.

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*H. C. Bates, Orillia, Ont.
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†Roger Brais, Montreal, Que.
‡J. H. Budden, Montreal, Que.
*P. E. Buss, Thorold, Ont.
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†C. H. R. Campling, Kingston, Ont.
†S. B. Cassidy, Fredericton, N.B.
§J. L. Charles, Winnipeg, Man.
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†G. J. Cote, Sherbrooke, Que.
†L. P. Dancose, Mont Joli, Que.
†W. A. Deveraux, Halifax, N.S.
†P. S. Dewar, Windsor, Ont.
*R. C. Eddy, Bathurst, N.B.
†P. F. Fairfull, Victoria, B.C.
†C. E. Frost, Montreal, Que.
*W. H. Gauvin, Montreal, Que.
§K. C. Graham, Moose Jaw, Sask.
†W. K. Gwyer, Trail, B.C.
*R. T. Hartland, Winnipeg, Man.
*E. L. Hartley, Vancouver, B.C.
*J. M. Hawkes, Cornwall, Ont.
*R. E. Hayes, Ottawa, Ont.
*D. C. Holgate, Sault Ste. Marie, Ont.
†M. W. Huggins, Toronto, Ont.
†G. E. Humphries, London, Ont.
†W. D. Hurst, Winnipeg, Man.
*C. G. Kingsmill, Montreal, Que.
*R. F. Legget, Ottawa, Ont.
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†Ernest Leja, Corner Brook, Nfld.
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OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Bruce Gilbert Dixon, M.E.I.C., retired diking commissioner with the Province of British Columbia, Victoria, B.C., died at New Westminster, B.C., in November, 1957.

Bruce Dixon was a maritimer, born at Hopewell Cape, N.B., on September 28, 1889. Awarded a B.Sc. degree in civil engineering at the University of New Brunswick in 1912 he undertook the post of chief of a hydrographic survey party on the Pitt and Fraser rivers in British Columbia at the outset of his career. Transitman on the revision of the location of the Pacific Great Eastern Railway in B.C. in 1913, he was in charge of highway location and construction of trails and bridges for the Strathcona Park Development on Vancouver Island.

With the advent of World War I Mr. Dixon offered his services to the Imperial Munitions Board where he was engaged in the testing of ammunition in 1915. For the remainder of the war he was involved in active service overseas with the Royal Canadian Artillery.

In 1919 Mr. Dixon joined the staff of the Taylor Engineering Company, taking charge of the construction of pipe lines and storage basins for the Alice Arm, B.C., hydro-electric installation.

Early in 1921 named inspector of dikes he became diking commissioner for Coquitlam, Pitt Meadows, Matsqui, and Maple Ridge, beginning more than thirty years service with the Province of British Columbia.

In 1948, following the flooding of the Fraser Valley, Mr. Dixon was named to the Fraser Valley Diking Board and was called to the post of diking commissioner for the Province. He was a member of the Federal-Provincial Board set up to study the overall problem of flood control in the Fraser Valley.

Mr. Dixon joined the Institute as a Junior Member in 1914 and transferred to Associate Member in 1923. He was named a Member in 1940.

Harry Stewart Van Scoyoc, M.E.I.C., retired advertising manager of the Canada Cement Company Limited, Montreal, died November 15, 1957 in that city.

Mr. Van Scoyoc was born on June 27, 1881 at Canaan, Pennsylvania. Awarded a B.Sc. degree in civil engineering at the University of Pennsylvania in 1907 his first professional responsibility was with the city of Altvona, Pa., as assistant engineer on road construction.

Mr. Van Scoyoc moved to Canada in 1912 to undertake the post of inspecting engineer assisting in the construction of concrete work throughout Canada. Thus began his long association with the Canada Cement Company Limited, Montreal.

During World War I Mr. Van Scoyoc was sent on loan to the Toronto and Hamilton Highway Commission as chief engineer during the construction of one of Canada's first major highways.

In 1918 he took over the post of consulting engineer of the Toronto, Hamilton highway Commission. At that time he was also named manager of publicity for the Canada Cement Company Limited, Montreal.

Named manager of the advertising and technical departments in 1931 he con-

H. S. Van Scoyoc, M.E.I.C.

tinued to hold office as such until his retirement in 1946.

For many years Mr. Van Scoyoc took an active part in advertising and sales organizations. In 1924 he was chosen to represent Canada at the world convention of the Associated Advertising Clubs of the World in London, England.

Mr. Van Scoyoc joined the Institute as an Associate Member in 1915, transferred to Member in 1921. He attained Life Membership in 1951.

William Jamieson, M.E.I.C., retired engineer, for many years associated with the Powell River Pulp and Paper Company, Powell River, B.C., died on June 21, 1957, in that city.

Born at Liverpool, England, on February 17, 1875, Mr. Jamieson obtained an engineering diploma at Liverpool University in 1895. One of his first posts was that of assistant engineer of the sewerage department of the Liverpool Corporation. In 1900 he served with British troops in South Africa then engaged in winning the Boer War.

He became resident engineer for the British Electric Traction Company Limited, at Worchester on his return to England, in 1901. Three years later he was construction engineer on bridge building and tramways over the Forth and Clyde Canal in Scotland.

In Shanghai in 1905 Mr. Jamieson was employed as superintendent engineer and agent on the construction of tramways.

He left the Orient in 1910 to join the engineering staff of the Kettle River Valley Railway as a waterworks engineer and superintendent of the district of North Vancouver.

During the thirteen years that followed he handled a number of appointments in the interior of B.C.

In 1924 began his long-term career with the Powell River Pulp and Paper Company. His first commission was concerned with the extension of Powell Lake Dam. For many years he served as a field engineer.

Mr. Jamieson retired in 1949. Nevertheless, he was able to continue his contribution to engineering in some measure, as consulting engineer for the Powell River Company and several other adjoining concerns.

Mr. Jamieson joined the Institute as a Member in 1925. He attained Life Membership in 1925.

John Stuart Slater, M.E.I.C., general manager of Pembina Pipeline Limited, died in Calgary, Alta., on October 20, 1957.

Born at Winnipeg on December 9, 1916, he moved to Vancouver at an early age. He attended Magee High School, in Vancouver. In 1944 he was awarded a B.A.Sc. degree in civil engineering at the University of British Columbia.

Beginning his graduate career as an assistant engineer with the Department of Public Works of Canada at New Westminster he gained experience with a number of firms in British Columbia before accepting the post of chief engineer for the Pembina Pipe Line Company Limited, Edmonton, in 1954.

During that period Mr. Slater was associated with the Western Bridge and Steel Fabricators, Vancouver, as an assistant engineer in 1946; the following year transferring his services to Bloedel, Stewart and Welch, Bloedel, B.C., in the same capacity. In 1948 named civil designer with the B.C. Electric Company at Vancouver, he remained there until 1951. Field engineer with Morrison Knudson Company of Canada Limited, Vancouver, later that year, he was associated with Canadian Bechtel Limited, Kamloops in 1953 and with B. D. Bohne and J. L. Miller Limited, consulting engineers, Vancouver.

Mr. Slater joined the Institute as a Student in 1943; became a Junior in 1946; and transferred to Member in 1951.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

QUEBEC

In a Nutshell

Quebec City and region members established a local chapter of the Corporation on December 6 when Council held its regular monthly meeting in Quebec City.

The president, **C. A. Peachey, P.Eng.**, has visited most of the Corporation regions; the tour, started in Rimouski in early autumn, took the president and some of the councillors as well as the general secretary **Pierre Bournival, P.-Eng.**, to the Northwestern, St. Maurice Valley, Lake St. John and Quebec regions. Members from the Eastern Townships and the Ottawa Valley will greet the president early in February.

W. W. Beaton, P.Eng., mining consultant of Noranda, Que., replaces Lucien Béliveau, P.Eng., as regional representative of the Northwestern region. A graduate of Queen's University (B.Sc. mining and metallurgy '26), Mr. Beaton is a member of the Corporation, the A.P.E.O., the C.I.M.M., the Canadian Legion, R.C.A.F. Associated, the Prospectors Association and is also Past-President of the Northwestern Quebec Branch of the Boy Scouts.

The Lake St. John members have recently elected **F. A. Brown, P.Eng.**, as their regional representative. Mr. Brown graduated from Queen's University in 1947 (B.Sc., electrical) and has been employed since that time by the Aluminum Company of Canada; he is presently assistant general superintendent, electrical division, Arvida Works. Mr. Brown replaced F. A. Dagg, P.Eng., as Lake St. John representative.

W. W. Beaton, P.Eng.

F. A. Brown, P.Eng.

Laval Faculty of Science has scored another first: creation of a Student Section of the Corporation. Promotion of professionalism will be its main concern.

ONTARIO

(Taken from The Professional Engineer, Journal of the Association of Professional Engineers of the Province of Ontario.)

Association Takes Stand

The Association's submission to the Gordon Commission, which was also forwarded to the Provincial Government, contained this paragraph — "The engineering profession is affected by the shortage that presently exists for all types of trained technicians. It is suggested that study should be given to the expansion of such senior technical schools as Ryerson Institute of Technology. There is a definite need for this type of senior technical school. It is, however, considered that rigid control of the curricula of such schools should be maintained to ensure that the graduates will be well-trained technicians rather than borderline engineers."

Retirement Plan Launched

The first group retirement savings plan for professional engineers in Canada has been launched by the Association of Professional Engineers of Ontario.

The plan consists of two methods of participation: purchase of a guaranteed insured annuity underwritten by North American Life Assurance Company; or purchase of common stock through the Chartered Trust Company. There is also a combination of both methods available. Minimum annual payment to the Plan is $200.00.

Under the common stock investment plan, members' savings are invested by the Chartered Trust Company. Members are allotted a number of units and each year receive a statement indicating the number of units standing to their credit.

ALBERTA

(An editorial taken from "The Alberta Professional Engineer", November 1957 issue by E. K. Cumming, chairman of the editorial committee.)

Confederation

The majority of the members of this Association and their fellow engineers throughout Canada are anxiously awaiting news of Confederation. In the June issue of the Professional Engineer it was reported that Canadian Council had adopted a plan which had been referred to Council of the Engineering Institute for the Annual meeting in June.

The E.I.C. Council, unable to adopt the plan in principle, referred it to their Committee for consideration. Arrangements for committees of Canadian Council and the E.I.C. to meet were delayed by vacations and the absence of J. Herbert Smith, chairman of the Canadian Council committee and originator of the idea.

Recently Mr. Smith was made president of his company and has found it necessary to resign as chairman of the committee, although he will continue as a member. The chairmanship has been given to John Fox, current president of the Association of Professional Engineers of Ontario. Arrangements are now being made for a meeting of the joint committee in early 1958.

There will be few engineers, if any, who will not welcome Confederation, and the end of their "split-personality". Such a change does not come easily. Only as a result of careful, sincere diagnosis and prescription will the patient develop a strong single personality. This important task lies with the able members of the joint committee who must not be forced to a hasty decision. On the other hand damage may be done by procrastination.

In any event it would be most ill-advised for either personality to attempt to proceed in its own way.

Personals

News of the Personal Activities of Members of the Institute

Rt. Honourable C. D. Howe, HON. M.E.I.C., was recently elected a director of Dominion Tar and Chemical Company, Limited.

D. S. Abbott, M.E.I.C., (B.Sc., mechanical, Queen's, 1930) of Howard Smith Paper Mills Limited, largest fine paper producer in the Commonwealth, has been elected president of the organization.

His career with the organization dates to the closing years of World War II. As manager of the plastics division of the company he devoted a number of years to the production of Arborite.

Since 1948 a member of the executive, Mr. Abbott was in 1954 appointed president of the Alliance Paper Mills and the Don Valley Paper Company. He was named president of Arborite in 1952. He is president of all Howard Smith subsidiary companies and a director of Consoweld Corporation and Continental-Diamond Fibre Company.

F. F. Fulton, M.E.I.C., (engineering diploma, Mount Allison University; B.Sc., electric, McGill, 1928) has been named general manager of the telephone contract division of Northern Electric Company Limited at Montreal.

Mr. Fulton joined Northern Electric in 1928 devoting the early part of his career to the field of electronics. He was appointed chief engineer of the electronics division in 1946. Within the last few years he has become assistant to the vice-president and managing director, and then general manager of the sales division.

R. N. Fournier, M.E.I.C.

A. B. Hunt, M.E.I.C.

Air Commodore V. H. Patriarche, M.E.I.C., (B.Sc., Manitoba, 1929) at Ottawa has received a posting to London, England where he will serve the Canadian Joint Staff. He was named chief of training at Air Force Headquarters, Ottawa.

R. N. Fournier, M.E.I.C., (engineering physics, Saskatchewan, 1937), has been appointed general manager of the wholesale department of the Canadian General Electric Company Limited, at the company's head office in Toronto. Mr. Fournier has held key managerial assignments in many of Canada's major marketing areas. In 1955 he was named manager of the Mid-West district in Winnipeg and held this position until his recent appointment.

F. F. Fulton, M.E.I.C.

D. S. Abbott, M.E.I.C.

Douglas C. Borden, M.E.I.C., (B.Sc., civil, McGill, 1924) of Montreal has been promoted to planning manager, communications equipment division with Northern Electric Company Limited, Montreal.

With the company for a number of years his most recent appointment was that of organization planning manager of the general sales division.

A. B. Hunt, M.E.I.C., (B.A.Sc., Toronto, 1928) formerly general manager of the telephone contract division of Northern Electric Company Limited, Montreal, has been appointed general manager, research and development for the organization.

During 1954-55 Mr. Hunt served as director of the electronics branch of the Department of Defence production.

E. H. Tovee, M.E.I.C., (B.A.Sc., electrical, Toronto, 1934) has been appointed director of quality control for the Canadian Westinghouse Company, Hamilton, Ont.

Mr. Tovee joined the firm in 1935. He has since 1953 co-ordinated the work of cost improvement teams throughout Westinghouse operating divisions.

W. D. Hurst, M.E.I.C., (B.Sc. civil, Manitoba, 1930; C.E., Virginia Polytechnic Institute, 1931) city engineer of

Photograph courtesy of Pirelli Cables, Conduits, Limited.

PERSONALS

Winnipeg and chairman of Commissioners of the Greater Winnipeg Water and Sanitary Districts was elected vice-president of the American Public Works Association at its annual meeting in Philadelphia on September 23.

Mr. Hurst's election culminated terms of service on the directorate of the Association as director-at-large, and as director of region 6. This consists of the American States of Iowa, Kansas, Minnesota, Nebraska, Missouri, North and South Dakota, and the Province of Manitoba.

J. Edward Goodman, M.E.I.C., (B.Sc., civil, Queen's, 1931) of Toronto, president of the J. E. Goodman Sales Limited, of Toronto has received the appointment of vice-president of Serviced Products (Canada) Limited. Mr. Goodman has an engineering background which includes thirty years' experience as project manager in road and heavy construction.

J. N. Cram, M.E.I.C., (B.Sc., chemical, Saskatchewan, 1937; B.Eng., mechanical, Nova Scotia Technical College, 1950) has transferred his engineering services from Toronto to Delora, Ont. Appointed manager of the Delora Smelting and Refining Company Limited, Mr. Cram was formerly associated with the Toronto firm of Crowthers Manufacturing Limited as sales manager.

Joseph A. D'Angelo, M.E.I.C., (B.Sc., electrical, 1946; B. Comm., Manitoba, 1957) has been appointed by Chrysler Corporation, Detroit, Michigan, as comptroller of the Joseph Campan Engine plant. More recently he was budget manager of the corporation's engine division.

W. H. Berry, M.E.I.C., (Birmingham, National Certificate, Central Technical College, 1938) has left his post as resident engineer for the British Malayan Petroleum Company Limited in Borneo to take up work for Shell Oil Company Limited at Maracaibo, Venezuela.

Mr. Berry has been employed in the British East Indies for several years. In 1952 he served as resident engineer for United British Oilfields of Trinidad Limited.

R. Walker, M.E.I.C., has moved to Western Canada to take over the post of chief electrical engineer with Associated Engineering Services Limited at Edmonton. Mr. Walker was formerly resident construction engineer with J. T. Donald & Co. (1956) Ltd., Montreal.

C. L. Cosser, M.E.I.C., (B.Sc., electrical, Cape Town, 1932) has left Montreal and is at work with an engineering concern in Southern Rhodesia. The firm, J. E. Stone and Company Limited is located at Salisbury.

Keeping in circulation?

We may not have the circulation problems of this young swain, but we too must keep our address book up-to-date. Your name is in it.

Once every year, the auditor from Canadian Circulations Audit Board Inc. checks our address records. If he checks your name, he will want proof of the business you are in, and that your address is correct. The proof may be a letter from you, or it may be a listing of your name in a directory, or it may be a salesman's report after calling upon you.

The auditor's most recent check of our circulation, summarized your name and others on our lists in this manner:

ANALYSIS OF CONTROLLED CIRCULATION by types of readers based on May 1957 Issue

Classification	Canada	Foreign	Total
Aircraft Industries	141	10	151
Chemical Industries	434	20	454
Communications and Transportation	498	6	504
Construction Materials Industries	278	9	287
Consulting Engineering Firms and Engineers in Private Practice	1,514	109	1,623
Contracting Engineering Firms	657	29	686
Electrical Manufacturers	822	32	854
Food Products Industries	86	5	91
Metal Products Industries	1,212	67	1,279
Marine and Shipbuilding Industries	54	1	55
Mining Industries	240	12	252
Petroleum Industries	541	30	571
Power Companies and Public-owned Power Utilities	778	12	790

Classification	Canada	Foreign	Total
Plastic Industries	14	...	14
Pulp and Paper Industries	411	18	429
Textile Industries	39	1	40
Wood Products Industries	39	2	41
Miscellaneous Industries	284	12	296
Industrial Services and Supplies	689	41	730
Government Services	1,484	56	1,540
Municipal Engineers	365	4	369
Educational Institutions, Associations and Libraries	454	325	779
Recent Engineering Graduates and Undergraduates	2,680	52	2,732
Retired Engineers	296	36	332
Unclassified	1,499	355	1,854
TOTAL	15,509	1,244	16,753
Average for the Period			17,034

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• PERSONALS

While in Montreal Mr. Cosser was employed with Northern Electric Company.

Commander W. B. Christie, M.E.I.C., (B.Eng., electrical, Nova Scotia Technical College, 1950) who was stationed in Great Britain for four years has held the post of assistant E.E.C. in C., at Naval Service headquarters, Ottawa since his return to Canada a number of months ago.

In Great Britain, Cmdr. Christie was acting electrical representative for the Royal Canadian Navy on the construction of the aircraft carrier, H.M.C.S. Bonaventure. He served as deputy electrical officer after the commissioning of the vessel.

J. F. Curran, M.E.I.C.

R. S. Cornell, M.E.I.C.

Richard S. Cornell, M.E.I.C., (B.Eng., chemical, McGill, 1949) who has for the past three years served the firm of Peacock Brothers Limited, as manager, pulp and paper division, has accepted the appointment of chief engineer with the chemical engineering company, Separator Engineering Limited, at Montreal. He has been elected a director in the firm.

Mr. Cornell was for three years associated with the Chemipulp Process Limited, pulp mill engineers.

John F. Curran, M.E.I.C., (B.Eng., civil, National University of Ireland) who came to Canada in 1951 has for a number of months held the responsibility of assistant Commissioner of Works for the City of Sarnia, Ont.

He was formerly with the Toronto consulting engineering firm of James F. MacLaren Associates.

Ronald B. Leeming, M.E.I.C., (Higher Nat. Certificate, Great Britain) has transferred from Vancouver to Montreal. He has accepted an engineering appointment with the Montreal Engineering Company Limited. Although Mr. Leeming was associated with this company previously, his address since 1956 has been c/o Sandwell and Company Limited, in the West Coast city.

Douglas O. Blake, M.E.I.C., (Higher National Certificate, 1946) until recently chief engineer of the Defence Research Laboratories, at Downsview, Ont., has moved to Montreal in order to accept a new appointment. The post he now fills is that of chief experimental engineer for Canadian Pratt and Whitney Aircraft Company Limited.

Major R. W. Potts, M.E.I.C., (B.Sc., civil, Saskatchewan, 1947) attending the Army Staff College at Camberley, Surrey, England, for the past year has been posted to Halifax, N.S., as D.A.A.G., manning, at Eastern Command headquarters.

Erik Hoel, M.E.I.C., (M.Sc., mechanical Technical University of Norway, 1947) has severed his connections with engineering in Toronto and is employed with Williams Brothers Sudamericana Limited, at Bogota, Colombia, S.A.

Mr. Hoel was formerly vice-president and manager of Dahl Brothers (Canada) Limited, in Toronto.

William Frederick Hull, M.E.I.C., (B.A.Sc., civil, Toronto, 1949) carrying on his engineering career in Africa for several years, has left Southern Rhodesia. His headquarters now in Capetown, South Africa, he is general manager of R. H. Morris, (Pty) Limited, building and civil engineering contractors. Mr. Hull was general manager with the firm of Laing and Roberts (Rhodesia) Limited while in Bulawayo, Rhodesia.

Boris Nebesar, M.E.I.C., (chemical, Prague, 1950) has left his employment at Sudbury, Ont., where he was with

• PERSONALS

the International Nickel Company and has accepted an appointment with the Northern Electric Company Limited at Montreal. His post is that of associate chemical engineer.

Gerald Malo, M.E.I.C., (B.A.Sc., civil, Ecole Polytechnique, 1948) has gained a Quebec City appointment as assistant to the district engineer, department of roads, Province of Quebec.

Mr. Malo formerly worked as division engineer for the Province of Quebec, Department of Roads, Cookshire, Que.

J. T. Kokotailo, M.E.I.C., (B.Sc., electrical, Alberta, 1949) has left Toronto where he was manager, industrial wiring & maintenance, with Magnetic Electric Company and has joined the staff of the Province of Saskatchewan as chief electrical inspector, Department of Labour, electrical inspection and licensing branch.

D. H. Pugsley, M.E.I.C., (B.Sc., mechanical, Saskatchewan, 1948) of the McColl Frontenac Oil Company Limited now holds the post of zone manager at the Lethbridge, Alta., office of the organization.

K. Madsen, M.E.I.C., (B.Sc., civil, Alberta, 1950) has joined the firm of Brown and Root Limited, at Calgary, Alta. His previous appointments have included work with the firm of H. G. Acres and Company Limited, Niagara Falls, Ont., and with the Provincial Institute of Technology and Art, Calgary.

R. N. Walker, M.E.I.C., (B.Sc., civil, Witwatersrand, Johannesburg 1950) has moved from Regina to Saskatoon, Sask., in order to accept an appointment as design engineer with the consulting engineering firm of Underwood, McLellan and Associates Limited. He formerly worked in the city engineers' department at the provincial capital.

G. L. Wilson, M.E.I.C., (B.A.Sc., civil, Toronto, 1951) has left Sudbury, Ont., where he was a director in the firm of E. M. Powell & Assoc. Ltd. He is presently carrying out engineering duties with Sprostons (Jamaica) Limited, a subsidiary of the Aluminum Company of Canada Limited in Kingston, Jamaica, B.W.I.

D. Segal, M.E.I.C., (B.A.Sc., civil, Toronto, 1953) has been transferred from St. John's, Newfoundland to Montreal, with The Warnock Hersey Company Limited. In Newfoundland Mr. Segal filled the post of branch manager for the organization.

D. T. Vanstone, JR.E.I.C., (B.Sc., chem., Queen's, 1951), has been transferred by his company, Du Pont Company of Canada (1956) Ltd., from the company's technical service group in Kingston to their sales development group at their

• PERSONALS

Montreal head office. Both of these positions are in Du Pont's textile fibres division. In Montreal, Mr. Vanstone will be working as a senior sales development representative on industrial applications of nylon and acrylic fibres.

J. C. Allen, JR.E.I.C., (B.Eng., mech., McGill, 1949), is presently employed as engineer with RCA Victor Company Limited, Montreal, He was formerly methods engineer with Northern Electric Company Ltd.

Jean Paul Cote, JR.E.I.C., (B.A.Sc., electrical, Laval, 1951) whose former employer was Pirelli Cables and Conduits Ltd., St. Jean, Que., is now with Canada Wire and Cables, Leaside, Ont.

Peter W. Brown, JR.E.I.C., (B.Sc., mechanical, Saskatchewan, 1954) is no longer with the Bailey Meter Co. Ltd., but has taken up duties in the office of the engineer-in-chief Naval Technical Services, Department of National Defence. Ottawa, Ont.

W. J. McNicol, JR.E.I.C., (B.A.Sc., mechanical, U.B.C., 1950) is appointed assistant Ontario district manager of the Canadian Westinghouse Company Ltd. He was formerly sales manager, for the company's motor-generator division at Hamilton.

K. M. McMillan, JR.E.I.C., (B.Sc., civil, Alberta, 1953) is presently employed as field operations manager, Pembina Pipe Line Ltd., Edmonton, Alberta. He was formerly with the Texaco Exploration Company.

Donald E. Lee, JR.E.I.C., (B.Sc., chemical, Alberta, 1956) is a research engineer in the research and development department of the Eldorado Mining and Refining Ltd., Eldorado, Sask.

David M. Derworiz, JR.E.I.C., (B.Sc., Mechanical, Sask., May 1955), who was employed for 2 years with Polymer Corporation Ltd., Sarnia, Ont., is now an inspection engineer for the McColl-Frontenac Oil Co. Ltd., Montreal.

M. C. Wolfe, JR.E.I.C., (B.Eng., mechanical, N.S.T.C, 1950) is chief engineer, Trenton Steel Division, Dominion Steel & Coal Corporation, Ltd, Trenton, N.S.

Arthur J. Shama, JR.E.I.C., (B.Eng., civil, McGill, 1948) is division engineer, Quebec Division, for Canadian Petrofina Limited, Montreal, Que. He was earlier a construction supervisor in Toronto.

R. N. Smith, JR.E.I.C., (B.A.Sc., electrical, U.B.C., 1951) is employed in the applied science division of International Business Machines Co. Ltd., Toronto.

Bruce Alexander, JR.E.I.C., (B.Sc., civil, Alberta 1955) has for some time been engaged in work as a designer for the

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firm of Wallace and Carruthers and Associates at Don Mills, Ont.

Prior to that time Mr. Alexander gained experience in working as a site engineer on the DEW Line.

G. W. T. Richardson, JR.E.I.C., (B.A.Sc., mechanical, Toronto, 1948) has been appointed superintendent of electrode production and plant maintenance at the Welland, Ont., plant of the Electro Metallurgical Company, division of Union Carbide Canada Limited.

Mr. Richardson's association with the Electro Metallurgical Company dates to his graduation. Previously he held the appointment of assistant superintendent of maintenance and services.

Joseph H. Amblard, JR.E.I.C., (B.Sc., Engineering and Business Administration, Massachusetts Institute of Technology, 1951) sales engineer for Process Steam Specialties Inc., Montreal, since 1953, now heads his own company, Associated Instrumentation & Controls Ltd., Montreal, as president.

J. C. Hungate, JR.E.I.C., (B.Eng., elec., McGill, 1951) is maintenance superintendent for Canada Iron Foundries at Three Rivers, Que.

E. J. Woods, JR.E.I.C., (B.A.Sc., electrical, British Columbia, 1947) previously works engineer at the James Island, B.C. explosives plant and Canadian Industries Limited, has now assumed duties as plant engineer at Lenkurt Electric Company in San Carlos, California.

Arthur P. Earle, JR.E.I.C., (B.Eng., electrical, McGill, 1949) is presently employed by The Shawinigan Water and Power Company, Montreal, as cost control engineer, production and plant department.

Olivier Y. Barde, JR.E.I.C., (engineering diploma, civil, Swiss Federal Institute of Technology, 1948) has severed his connections with C. D. Howe and Associates Limited and has joined the Montreal firm of Miron, Sterling and Walsh.

J. D. Sikal, JR.E.I.C., (B.Sc., civil, Alberta, 1949) is employed as a site engineer for the Bell Telephone Company of Canada at Schefferville, Que. Earlier this year he was located at Dawson Creek, B.C.

G. C. Willeumier, JR.E.I.C., (civil, Technical University of Delft, Holland, 1949) has accepted a position with C.B.A. Engineering Limited at Vancouver, B.C.

For the past few years Mr. Willeumier has been employed in Montreal with the firms of Beauchemin and Hurter, surveying and designing, and with H. S. Pratley, consulting engineers, both of Montreal.

J. S. Baldwin, JR.E.I.C., (B.Sc., chemical, Saskatchewan, 1951) is now employed by the Boeing Airplane Company, Seattle, Wash., as a liaison planning engineer. He was formerly associated with the Canadian Arsenals Limited, as a supervisor, propellants department, Valleyfield, Que.

F. C. Bertrand, JR.E.I.C., (B. Eng., mechanical, McGill, 1953) is working for the Canada Iron Foundries Limited, Three Rivers, Que. He was formerly associated with the Anglo-Canadian Pulp and Paper Mills as a maintenance engineer.

Robert Boisvert, JR.E.I.C., (B.Eng., mechanical, McGill, 1952) has transferred his services from the Fluor Corporation Limited, Toronto, as project engineer to the Moulton Company Limited, Montreal.

E. N. Yaramy, JR.E.I.C., (B.Sc., mechanical, Queen's, 1954) who has been with Taylor Instrument Company Limited since his graduation has recently been transferred from Montreal to Toronto.

F. R. Long, JR.E.I.C., (B.Sc., mechanical New Brunswick, 1955), design engineer with Canadian International Paper Company Limited, in Dalhousie, N.B., has now joined Racey MacCallum & Assocates, at Montreal, Que.

G. M. Ross, JR.E.I.C., (B.Eng., electrical McGill, 1955) is presently employed as engineer in the Microwave Group of Standard Telephones & Cables Manufacturing Company (Canada) Ltd., Montreal, Que.

J. A. Pickard, S.E.I.C., (B.Sc., mech., Queen's, 1957) is employed as design engineer, in the design engineering department of the E. B. Eddy Company Ltd., Hull, Que.

R. Lapinas, S.E.I.C., (B.Eng., civil, McGill, 1957) is assistant concrete engineer, with the technical control division of the Mount Royal Paving and Supplies Limited, at Montreal.

Louis Pertus, S.E.I.C., (B.Sc., civil, New Brunswick, 1957) has joined the Department of Transport, Montreal airport, as district construction engineer.

L. R. McCartney, S.E.I.C., (B.Sc., civil, Queen's, 1957), is assistant city engineer for the City of Guelph, Ontario.

G. T. Dewhurst, S.E.I.C., (B.Eng., mechanical, Saskatchewan, 1957), is application engineer with Honeywell Controls Limited, Calgary, Alberta.

Louis E. Deveau, S.E.I.C., (B.Eng., mechanical, Nova Scotia Technical School, 1956) is employed with the Moncton Foundry and Machine Company Limited, Moncton, N.B., and is engaged in the work of designing and estimating for the firm.

NEWS OF THE BRANCHES

Activities of the Forty-Nine Branches of the Institute and abstracts of the papers presented at their meetings

BELLEVILLE

E. T. Hilbig, JR.E.I.C., *Sec.-Treas.*

T. E. Flynn,
Branch News Reporter

On Monday, November 11, 1957, the Belleville Branch held a joint meeting with the Bay of Quinte Section of the I.R.E. in Belleville. Chairmanship of the meeting was shared by Mr. John Grant of the E.I.C. and Mr. Ryan of the I.R.E.

After matters of routine business were completed by the joint chairmen, Mr. Grant introduced Mr. Robert Tanner of the Northern Electric Company, guest speaker.

Mr. Tanner received his bachelor's degree in science and post-graduate degree at London University. He worked for the British Broadcasting Corporation, served in the British Army during World War II and in 1947 came to Canada to work for the Northern Electric Co. He is in charge of the development engineering department at the Northern Electric Co. in Belleville. He is engaged on the acoustical problems involved in the design of public buildings.

Acoustics Ancient Problem

Mr. Tanner stated that the study of architectural acoustics dates to ancient times. He cited the design of the Greek theatres as quite an acoustical achievement. During the last 50 or 60 years, there has been intensive study in this field and nowadays the acoustical characteristics of a building can be predicted quite accurately.

Mr. Tanner stated that the best acoustical design for a building does not usually satisfy the architect. Therefore, one can never achieve a perfect acoustical design. As in many other fields, a compromise must be reached.

Mr. Tanner said that the design of the permanent Stratford Shakespearean Theatre, Stratford, Ont., was begun in December, 1955. The acoustics of the building was one of the matters to which thought was first given. This theatre had developed a type of actor who had proved very popular with the public. It was desired to incorporate in the permanent building many of the features of the temporary tent theatre. However, the permanent building required the installation of a balcony and this, in turn, required that the ceiling should be higher.

The theatre is circular in design with the centre of the stage at the centre of the circle. The design of the rear wall behind the actors was the first problem encountered. This wall was constructed of open surface texture concrete blocks covered by perforated steel painted blue.

DEEP RIVER, ONT.: Formation of a Branch of the E.I.C., to serve Deep River, Ont., was the subject of discussion when Colonel L. F. Grant, field secretary of the E.I.C., and thirty professional engineers of the area gathered at a dinner meeting on November 14 in the Ontario town. Top photo; l. to r. are: standing, H. F. Pragnell, H. Chaput, Col. Grant; J. S. Flavelle, W. G. Allen. Seated: B. P. Scull, W. E. Erlehach and E. A. Moore. Lower photo shows (back) D. M. Hayter, P. G. Ashbaugh, J. B. Gordon, F. A. McIntosh, W. Arasuk; (front row) R. O. Sochaski, C. E. L. Hunt, A. E. Hart, E. W. Fee, and J. G. Melvin.

● BRANCH NEWS

This wall has a zigzag form, and besides having a pleasant appearance, it was found to diffuse sound adequately.

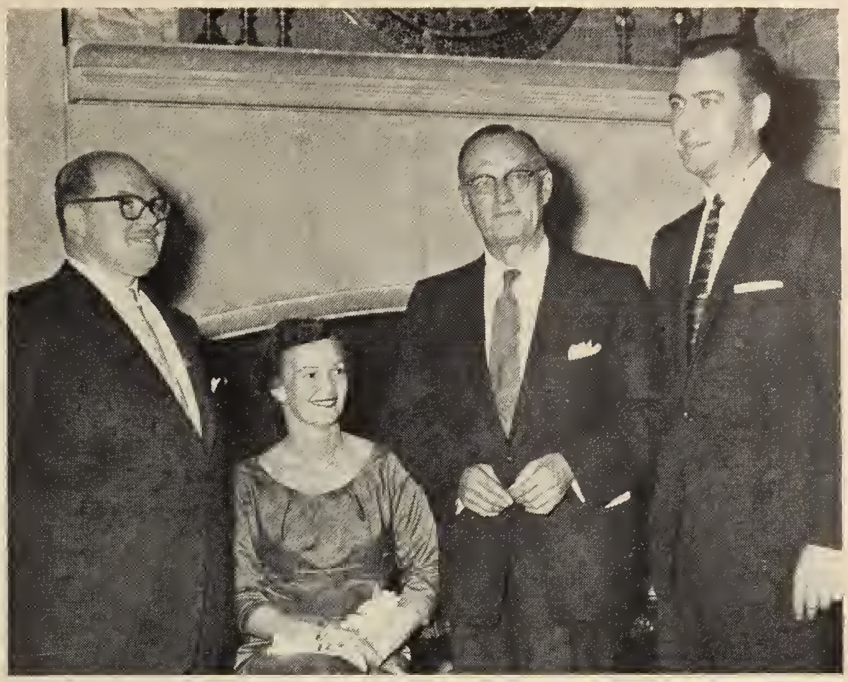
The design of the ceiling was problem No. 2. Due to the layout of the theatre, an actor has his back to part of the audience at times. The problem in designing the ceiling was to secure the reflection of his voice back to the audience behind him with the shortest possible time delay.

As the audience itself is an important factor acoustically, the padded chairs in the theatre were designed to have an absorption factor as near as possible to that of a human being.

Mr. Tanner stated that one of the most difficult problems he faced was the calculation of the volume of the theatre. This was made difficult by its unusual design. The volume is about 300,000 cu. ft. and there are 2200 seats.

It was desired to install an orchestra pit, but instead of placing the orchestra in the usual position between the actors and the audience, it was placed underneath the ceiling behind the stage balcony.

Mr. Tanner stated that the whole building was constructed in 10 months. Measurement of reverberation times using a revolver and tape recorder gave



BORDER CITIES: The President Visits Windsor, Ont. C. M. Anson, president of the E.I.C. was guest speaker and guest of honour at the dinner-dance, October 25, at Essex Golf Club, Windsor, Ont. With Mr. Anson are: (l. to r.), Dr. G. T. Page, deputy general secretary, E.I.C., Mrs. P. N. Brown, president of the Women's Auxiliary to the Institute, Windsor; C. M. Anson; and P. N. Brown, Branch chairman. During the afternoon preceding the dance Mr. Anson and Dr. Page met with the Branch executive for an informal discussion of current Institute activities.

results very close to the design calculations.

After a question and answer period, Mr. Ryan of the I.R.E. thanked the speaker and the meeting adjourned for refreshments.

HAMILTON

W. A. H. Filer, JR.E.I.C., *Sec.-Treas.*

J. R. Currie, M.E.I.C., *Branch News Editor*

THE NOVEMBER MEETING of the Branch was held November 14 at the Westdale Hotel. One hundred and fifty members heard Alfred Hedefine, introduced by W. A. Whetan, deliver a talk on the proposed Eastern and Western Expressway connections for the City of Hamilton. Mr. Hedefine is a partner in the consulting firm of Parsons, Brinckerhoff, Hall, & Macdonald, of New York which firm, together with C. C. Parker & Associates Ltd. of Hamilton, have been engaged by the City of Hamilton to work out the solution to the traffic problems at the eastern and western entrances to the city.

Mr. Hedefine pointed out that the two basic problems in the consideration of this study were, that Hamilton is located on the main traffic routes between Toronto and Buffalo to the east, and Toronto and Detroit to the west, and secondly, that owing to the geography of the area, the traffic in the west must pass through a built up area. Coloured slides were shown illustrating many of the proposals considered.

In connection with the Eastern Expressway connections, Mr. Hedefine proposed the building of what he termed The Red Hill Creek Expressway which would be an internal connection within the city with three interchanges, the principal ones to be Woodward Avenue and Beach Road. This expressway would connect to the present interchange at Burlington Street which is now under construction. Several studies of the proposed interchanges at Beach Road and Burlington Street were presented.

Two or three possible solutions to the Western connections were studied, taking into account the geographical conditions and the future port expansion. Studies were presented showing the two types of road bed proposed, either concrete highway or flexible pavement construction.

In response to questions from the floor, Mr. Hedefine estimated that the Eastern connections might cost approximately $12,000,000.00, the Western connections $18,000,000.00 based on today's costs. As the Burlington Skyway is now under construction, Mr. Hedefine thought that the Eastern connections were the more urgent necessity at the present time.

LETHBRIDGE

R. D. Hall, JR.E.I.C., *Sec.-Treas.*

R. F. Smith, JR.E.I.C., *Branch News Editor*

THE ANNUAL JOINT MEETING of the Association of Professional Engineers and the Lethbridge Branch of the Institute was held October 19. Fifty members attended.

Presided over jointly by Dr. J. C. Sproule, president of the A.P.E.A. and J. R. Milne, chairman of the Lethbridge Branch, E.I.C., among those attending the meeting were J. F. McDougall, Edmonton, registrar for the A.P.E.A.; A. E. McDonald, Edmonton, executive secretary of the A.P.E.A.; Commodore A. C. M. Davy, Vancouver, Western Field Secretary for the E.I.C.; and J. Hanna, Calgary, alderman and engineer.

J. C. Dale Guest Speaker

J. C. Dale, of Edmonton, president and general manager of Canadian Utilities Limited and president of the Canadian Electrical Association, in dealing with the vast potential of Canada's Northland, the problems and necessity of developing it, told the assembly, "Some day we are going to need, and need des-

perately, what the North has to offer." He warned, "We should at least now begin to try to solve the problems which must be solved before we can take what is being held in trust for our use."

Mr. Dale stated that the Yukon consists largely of the North land extension of the Cordilleras and their flanks. The eastern two-thirds of the main land of the North West Territories and much of the Arctic Island are the great metal bearing regions of the North American continent.

The geology of the North promises a wide range of mineral resources. Mr. Dale explained that an assortment has already been located. These included gold, silver, lead, coal, zinc, cadmium, copper, tungsten, platinum, antimony, nickel, radium and asbestos. All of these minerals have been produced. Examples of others known to exist are tin, iron, gypsum, monozite, molybdenum, arsenic, fluorite, and bismuth.

Stumbling Block

The greatest stumbling block to northern development at present, he felt, is the high cost of transportation.

It may be possible, he said, for thermo-electric plants to supply the power necessary to mining industries, due to the existence of oil, gas, and coal for diesel, gas turbine, or steam turbine plants.

Mr. Dale went on to explain that nuclear power plants are frequently considered the answer to the problem of the supply of energy in areas deficient in fuel and hydro power.

Mr. Dale concluded his remarks with the statement that, "the Northland's storehouse of mineral wealth can make an important contribution to the world's energy supply through its supply of uranium and oil. The hydro-electric potential of such areas as the upper waters of the Yukon, the recently announced Wenner-Gren Rocky Mountain trench scheme and the Hamilton River, Grand Falls site, each in the order of 4,000,000 horsepower are available for projects of the magnitude of Kitimat and greater." He stipulated, however, that, "The wealth remains a potential. Exploitation will not be without difficulty, successful development will depend largely on ingenuity, resourcefulness and the technical ability of those accepting the challenge. The challenge offered is of particular interest to engineers.

PETERBOROUGH

D. B. Chase, JR.E.I.C., *Sec.-Treas.*

V. Aare, M.E.I.C., *Publicity Chairman*

FIRST FALL MEETING was held at the Peterborough Armouries on September 25, 1957 with the double purpose of spotlighting engineers and engineering in the army, and combining it with a Ladies' Night program.

A reception in the Officers Mess was followed by a talk on "Engineers and the Army of Today," by Major W. Reid, chief instructor, R.C.E.M.E. School, Kingston, Ont., who demonstrated with the help of statistics the importance of engineers in a modern army designed for atomic warfare.

An inspection of the technical equipment at the armouries preceded a pipe band display and a dismissal parade of the 28th Technical Squadron, R.C.E.M.E. Major T. E. Duffield, officer commanding the Squadron who was host for the evening was responsible for the interesting program.

F. R. Pope and W. C. Durant, presented golf prizes to the winners of the Peterborough district E.I.C., and professional engineers Golf Tournament held in August. The "R. L. Dobbin Trophy", donated by R. L. Dobbin, past president of the E.I.C. was won by V. A. Taylor. A picture recording this event appeared in the December issue of the *Journal*, page 1870.

Greetings were sent to R. L. Dobbin, confined to hospital recovering from a heart attack, and unable to present the trophy as originally planned.

Attended by 70 couples, the evening ended with dancing and lunch provided by Mrs. H. R. Sills, and other members of the E.I.C. ladies' Auxilliary.

The Branch was honoured by the visit on October 21, of President C. M. Anson and General Secretary Dr. L. Austin Wright who spent a busy day in Peterborough.

At a Branch executive meeting which included the Belleville and Huronia Branches 15 items ranging from membership to confederation were discussed.

The president's party then toured the Peterborough works of the Canadian General Electric Company. Guides were W. H. Ackhurst, Branch chairman; H. R. Sills, E.I.C. vice-president; and W. G. Ward, general manager, apparatus department, of C.G.E.

A dinner meeting, attended by 70 members was arranged for the evening. Mr. Anson's talk, "The Engineer in Management," concerned with engineers, industrial organization and labour relations, drew great interest.

The monthly technical meeting of the Branch attended by 50 members took place November 5, 1957.

H. Lloyd Johnston, chief engineer of Du Pont Company of Canada, guest speaker, gave a talk on "Evaluating Performance in an Engineering Department." He outlined the different methods used to evaluate engineering work. The performance cannot be measured with direct production as it is the case with shop labour. Consequently the methods used are often quite complicated. Mr. Johnston reviewed his own method which is a combination of several others commonly used in the industry.

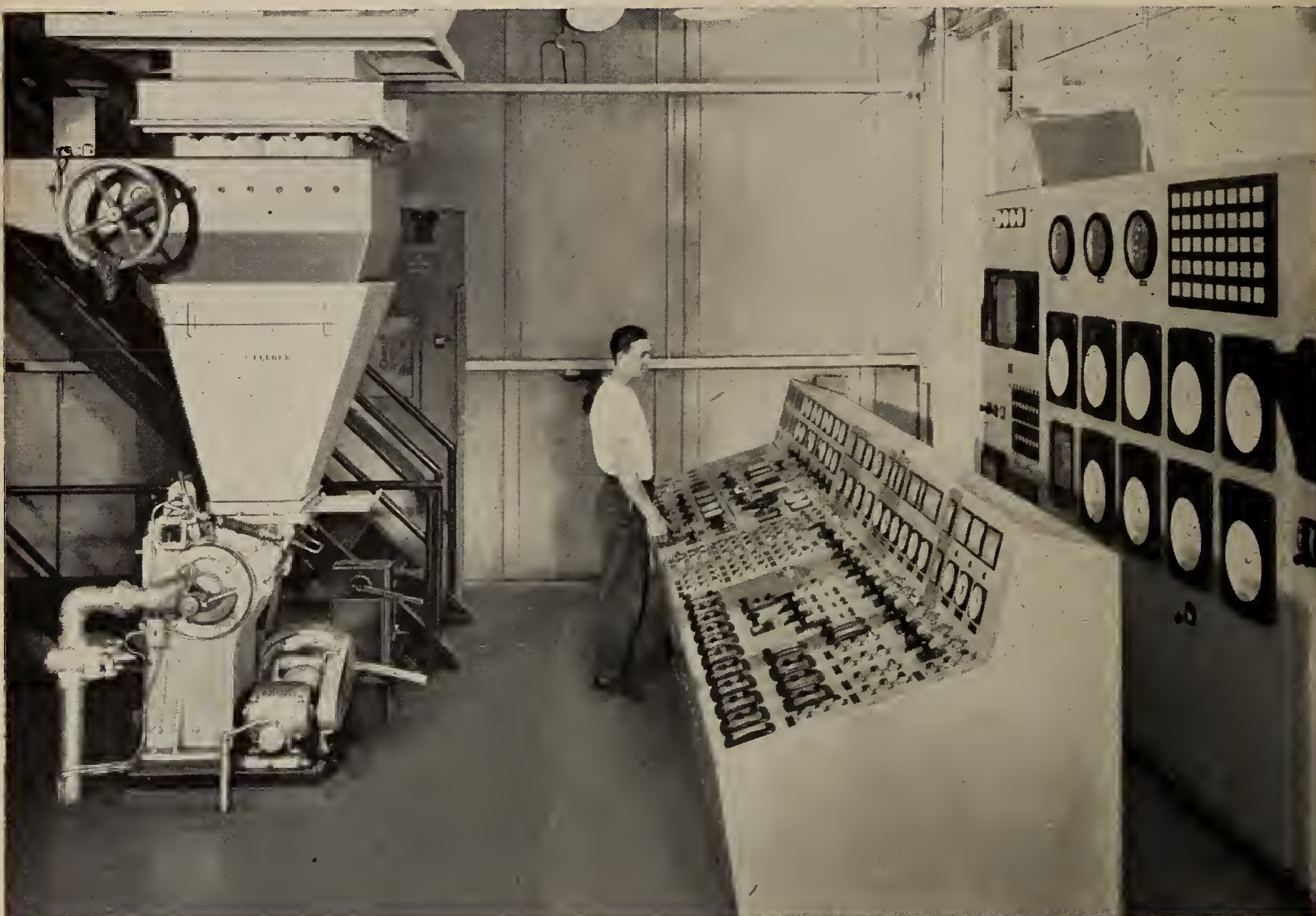
As the majority of engineers resident in Peterborough are associated with large engineering departments, the meeting was of great interest to them.

SASKATCHEWAN

R. Bing-Wo, M.E.I.C., *Sec.-Treas.*

THE SASKATOON SECTION of the Branch held a dinner meeting on November 15. Forty-five members, turned out for the event which included an address read by Dr. J. D. Mollard of J. D. Mollard

BAILEY Mini-line Controls



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Dealing specifically with "Air Surveys Knowledge of Natural Resources," Dr. Millard stressed the urgent need for studies of the resources of the earth to meet the ever increasing demands of world population. Perhaps unique in Canada in his photo interpretation of aerial studies, Dr. Mollard outlined phases of this work which vary from gravel searches in the construction of railroads, highways, and for construction generally to the latest development of petroleum searches. This is done through a study of cracks in the earth's crust.

Professor B. B. Torchinsky expressed the thanks of the Section for the informative talk.

On tour of Canadian General Electric Company Limited's Peterborough, Ont., Works, members of the presidential party observe the rotor spider of one of the generators used in the construction of the St. Lawrence Power project. L. to r. are: E. L. Cavana; Dr. G. T. Page, deputy general secretary of the Institute; H. C. Bates; W. H. Ackhurst, Branch chairman; C. M. Anson, E.I.C. president; W. G. Ward; H. R. Sills, a vice-president of the Institute, and Dr. L. A. Wright, general secretary of the Institute.

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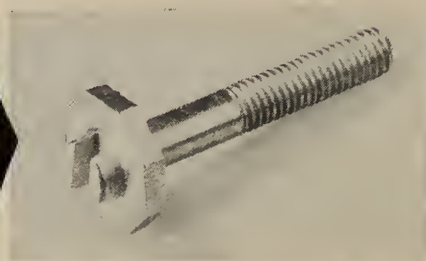

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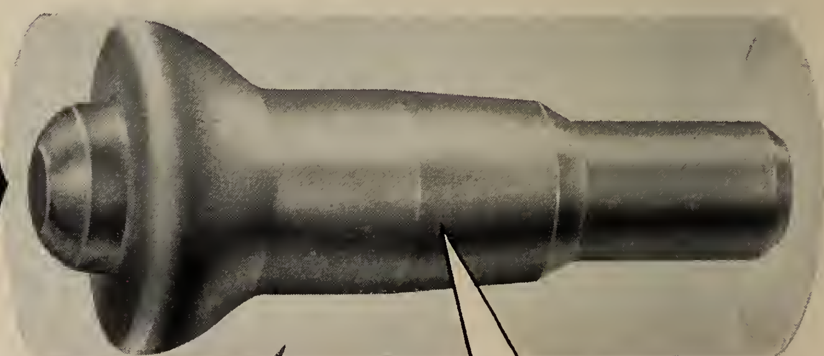

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• BRANCH NEWS

Chairman W. G. McKay reported on the activities of the provincial Association. His talk included an outline of the proposal that the annual meeting be held February 22, in Saskatoon.

Mr. McKay also announced that one copy of the E.I.C. publication, "Daylight Through the Mountain," had been presented to the City of Saskatoon Public Library on behalf of the Saskatoon Section.

Professor J. B. Mantle, E.I.C. Councillor, provided a report and summarized various items from the minutes of the previous meeting. Part of his remarks were concerned with the announcement that a Canadian Engineering Council has been formed. Service rendered by engineers elected to the Council was outlined.

It was reported that Professional Development Courses are underway in the city. Chairman S. J. Warder is in charge.

YORKTON SECTION

D. Matheson, M.E.I.C., *Sec.-Treas.*

The Yorkton Section of the Saskatchewan Branch E.I.C. was formed on November 8, 1957. Promoted through the efforts of J. B. Sveinbjornson, M.E.I.C., city engineer, a group of engineers assembled at the Yorkton Hotel to consider formation of the group. Those present were: I. B. Sveinbjornson, R. Brown, D. Matheson, W. Riddell, H. Hansen of the Kamsack area, E. Staible, and J. Ayles. Visitors attending this unique meeting were W. G. McKay, of the Saskatoon Section, John Mantle, Councillor, Saskatchewan Branch, A. Sherrett and F. W. Catterall, of the Saskatoon Section.

Chairman of the new section I. B. Sveinbjornson; vice-chairman, R. Brown; D. Matheson, secretary-treasurer.

Addresses were read by W. G. McKay and J. Mantle. A program of activities was discussed and regular meetings planned to occur alternate Friday evenings. Institute-Association affairs were a feature in the discussion.

The meeting adjourned with an expression of appreciation to all who assisted in the formation of the Yorkton Section.

SUDBURY

M. D. Head, M.E.I.C., *Publicity Committee*

The November dinner meeting of the Sudbury branch of the Engineering Institute of Canada was held at the Sudbury Granite Club on November 14. Forty one members and guests attended. R. C. Crawford introduced W. Moore of the Meehanite Metal Corporation who presented an informative film on casting design and foundry practice and discussed these subjects. He stressed the need for close liaison between the design engineer, the pattern maker and the foundryman. Most metals contract on solidification and cooling, resulting in residual casting stresses. Shrink defects may occur if the design does not provide for the location of feeder heads to offset liquid shrinkage. The most common casting defects are "hot spots", or points of interruption of free cooling. It is therefore desirable to strive for a casting design that will permit uniform cooling. When possible, thickness of all sections should be equalised, and abrupt section changes should be avoided.

Mr. Moore continued by referring to the outstanding versatility of iron castings. Compositions and textures can be modified to provide tensile strengths comparable to alloy steels as well as superior machinability and freedom from notch sensitivity. The type of structure required can usually be obtained by suitable choice of graphite content, dependent on the cooling rate of the casting, and the allowable range of cooling rates can be widened by the use of suitable alloys.

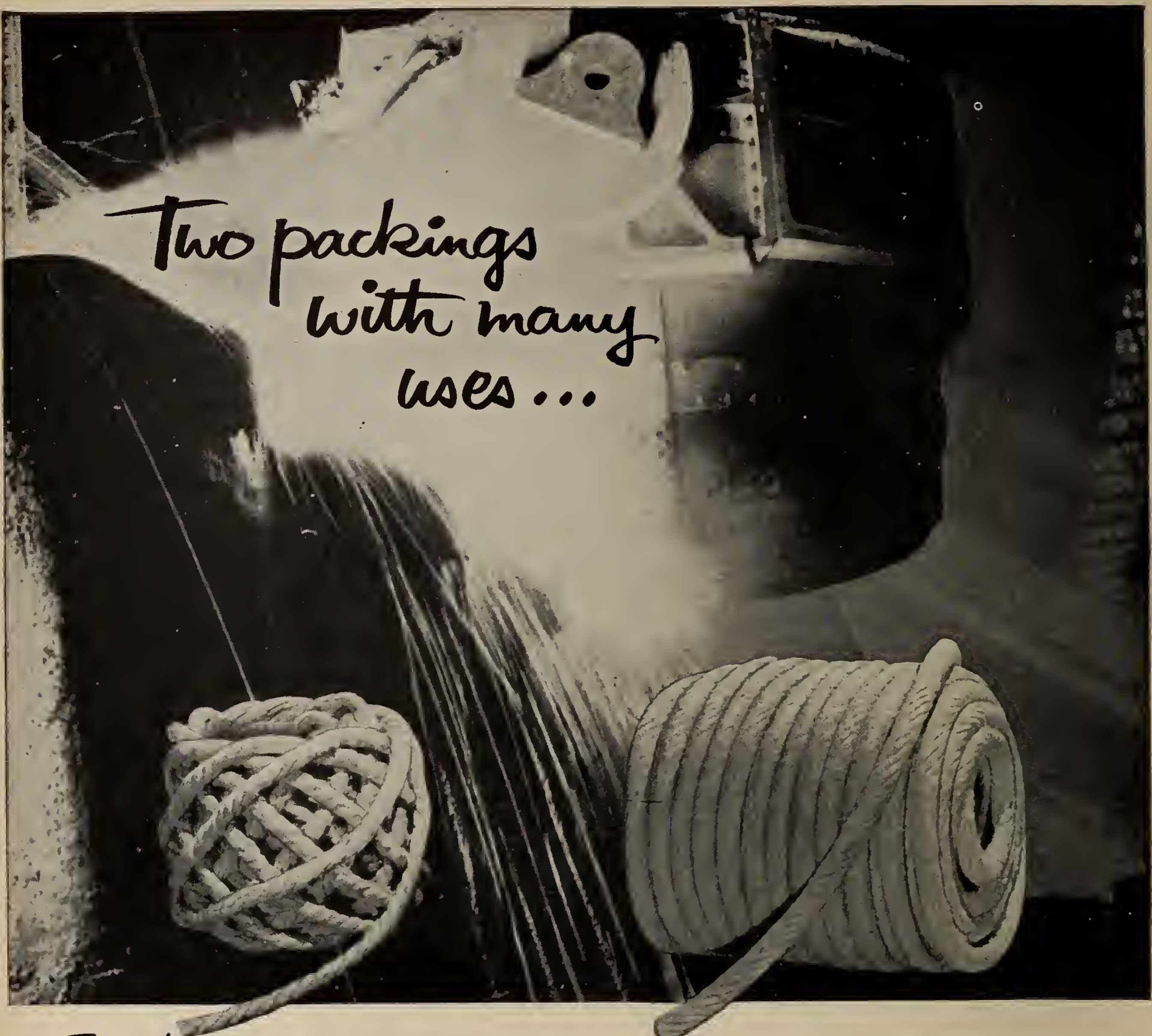
In a question period at the end of his talk, W. Moore discussed the production and qualities of nodular irons, the relationship between test section chill values and casting section, and other topics of interest.

TORONTO

D. S. Moyer, M.E.I.C., *Sec.-Treas.*

A. C. Davidson, M.E.I.C.,
Branch News Editor

At a joint meeting of the C.I.C.-E.I.C., held November 21, an audience of 60



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• BRANCH NEWS

members heard Dr. Donald B. Keyes reminisce upon the painful lessons learned in 19 years as a professor in the faculty of chemical engineering, University of Illinois. Dr. Keyes was introduced by Dr. A. E. R. Watson of the Ontario Research Foundation.

For the benefit of those who have gone through the learning process themselves, Dr. Keyes enumerated certain fundamental facts relative to the process of teaching at a university level known to most professors. A professor must of course educate himself, otherwise how would he become a professor? The teacher must reach the individual, and not treat a class of students as a class. This is the costly way to do the best teaching, because it means there must be more good teachers to reach every individual. The large university is, according to Dr. Keyes, an educational foundry or factory; the small liberal arts college is best for carrying out this idea of the teacher reaching every student.

Dr. Keyes emphasized the fact that the success of any student after he leaves college depends on his knowledge and interest in many fields outside the engineering sciences. The major problems which will confront him will never lie in his specialist field.

Some of the difficulties which had to be overcome in developing his course in chemical engineering at the University of Illinois were related by Dr. Keyes.

Dr. Keyes wound up his talk by citing five points on the better utilization of engineers which have been developed by skilled psychologists:

1. The engineer should be treated as an individual and not on a class basis.
2. Pay and fringe benefits should be adequate, but not more than adequate.
3. Men who are scientists and engineers should be given a challenge somewhat beyond the level of their capacity.
4. Scientists and engineers work best when they have the utmost freedom to solve a problem.
5. Scientists and engineers, when they have solved a problem should be rewarded. This is not necessarily a monetary reward.

Arrangements for the meeting were directed by Douglas Abbey.

Metropolitan Government

F. G. Gardiner, chairman of the Toronto Metropolitan Area Council on November 7 addressed 125 members of the E.I.C. and the A.I.E.E., Toronto Branches.

Mr. Gardiner was introduced by Eric Hardy, director of municipal research, who gave a short resume of his career in municipal affairs, clarifying the fact that in the position of chairman of Metro-Toronto Mr. Gardiner was not popularly elected, but elected indirectly.

Mr. Gardiner remarked that his generation had seen more changes technically than any other, and that the phenomenon of suburbanization is one of the more amazing of these changes.

The population of Toronto has remained static at about 700,000, while the suburbs surrounding the city have jumped from 145,000 to 800,000 between 1945 and 1957. At present the Metro form of government might be thought of as "Balkanized", he felt. It consists of 1 city, 4 towns and 5 organized townships, which at times conduct their affairs as independent entities in so far as the good of the whole may be concerned.

At the end of World War II a sudden rush to the country was felt. The problems which developed were a consequence of the desire of the new inhabitants to have all the advantages of the country, as well as urban amenities.

All the services have to be supplied eventually Mr. Gardiner explained. This takes time and inevitably leaves a backlog of unfinished business, which irks the suburbanite. Although the metro services and the suburban services are behind, the backlog has been reduced.

Lessons have been learned. Enactment of legislation accomplishes nothing, but it does provide a vehicle. With the legislation available the next thing to do is take one step at a time, and to work with patience and persistence and perserverance. The progress made in the Metro Toronto plan has been better than expected.

The membership of metro council is equally divided between the city and the suburbs. Mr. Gardiner expressed pleasure that the council have adopted a broader, metro viewpoint. The expenditures made in Metro Toronto are investments to attract industry so that care may be given residential development. There is no difference between operating a business and operating Metro. Any business must attract customers, he felt.

At present the greatest problem is borrowing money, Taxes at present are not sufficient to pay for the services.

Traffic a Problem

Traffic is an urgent problem. Toronto has to move some 450,000 vehicles in the area plus 100,000 from outside the area each day. Statistics were quoted to show the importance of the automobile industry to the Canadian economy. A little reflection will demonstrate its importance, he said. If the automobile were not driven, the economy would suffer. On the other hand, public transport is needed, but quicker and better service will not be obtained by abusing the driver of an automobile. Mr. Gardiner reviewed some attempts which have been made to cope with the public transport problem. The Boston subway system was not correctly situated because no one foresaw the tremendous increase in the use of the automobile. Los Angeles is without public transportation. Parking is therefore very difficult, strangling east-west communication in the city. Chicago's Congress Street combination of rapid transit and freeway look like a promising solution. This is being tried on a small scale in the west end of Metro Toronto. As a consequence of these past errors and future uncertainties, Mr. Gardiner emphasized the need for assurance that the proposed east-west subway will serve the best interests of the community.

As to federal-provincial-municipal relations Mr. Gardiner called for a more equitable share of taxes to be returned to the cities. For example, Toronto metro area provides about 27% of the federal income taxes and succession duties, while Ontario yields about 50% of the total.

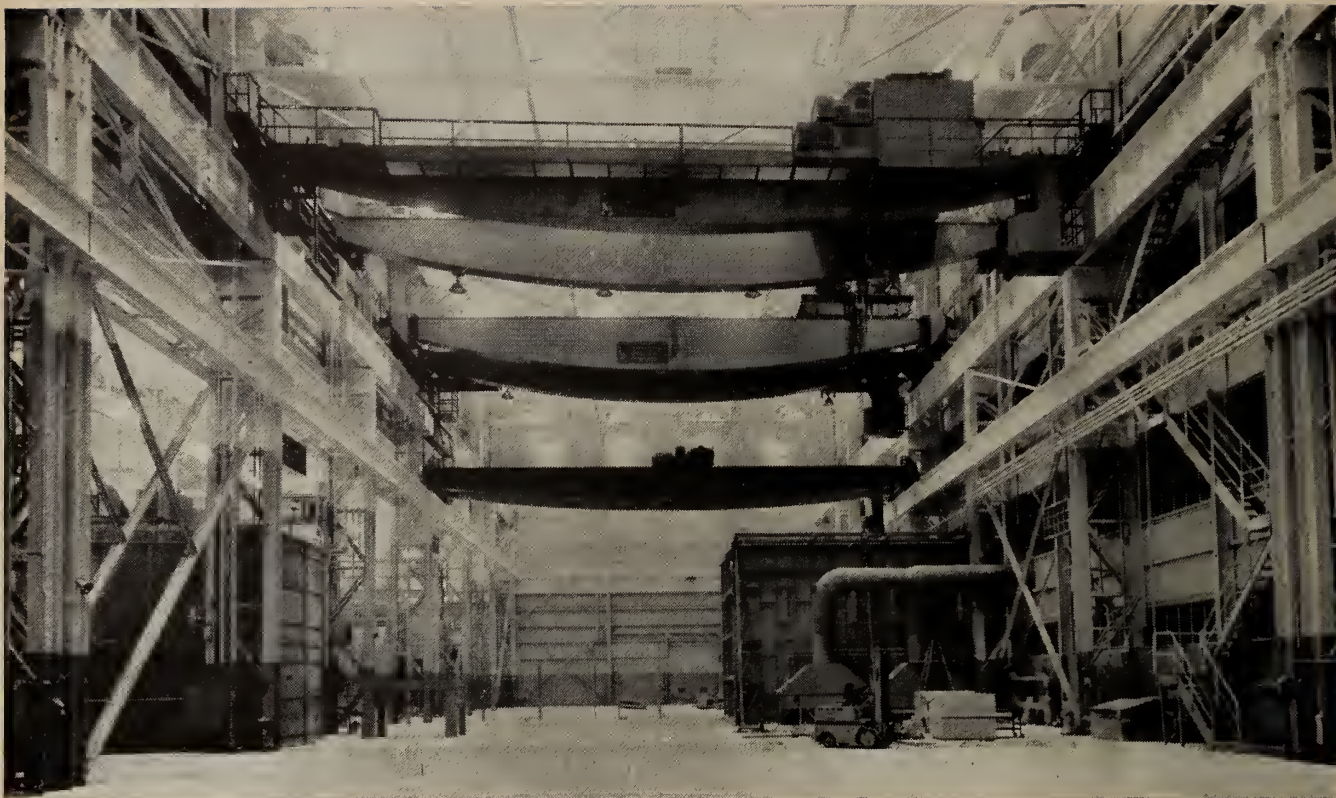
Future Annual Meetings

E.I.C., 1958

Quebec, Chateau Frontenac, May 21, 22, 23

1959

Toronto, Royal York Hotel, June 8, 9, 10



In closing, Mr. Gardiner pointed out that opportunities in Metro Toronto were matchless for those who have the courage and the strength to seize them.

Joint Committee Meeting

Members of the joint committee of the E.I.C. and the Institution of Electrical Engineers met on November 12, 1957 for a visit to the R. L. Hearn Steam-Generating Station of the Ontario Hydro Electric Power Commission.

Initial installation at this station was four 100 MW turbo-alternator units with the last unit commissioned in June 1953.

Four additional 200 MW units are to be added to make an ultimate installed capacity of 1200 MW.

This is the largest steam generating station in Canada. When the four new units are finally commissioned it will rank among the largest in North America.

VANCOUVER

A. D. Cronk, JR.E.I.C., *Secretary*

R. C. McMordie, chief engineer of the B.C. Power Commission addressed the Vancouver Branch of the E.I.C. on the question of "Meeting the Load Growth of the B.C. Power Commission," at a meeting held November 27.

From the initial installed capacity of 4200 k.w. and gross assets totalling $2,400,000 the B.C. Power Commission's plant increased to the present 331,000 k.w. installed generating capacity and 152,000,000 worth of assets since its inception in 1945.

In spite of its growth the B.C. Power Commission is so far still a small enterprise as compared to the eldest provincially owned public power utility. Ontario Hydro has 2 billion dollars worth of assets.

In the early days many small distribution systems in existence were unable to supply satisfactory services at reasonable rates. Such a need still exists today in spite of the spectacular growth of the B.C. Power Commission.

Mr. McMordie said that the operations of the B.C. Power Commission are not subsidized. Sole source of revenue is from the sale of the electrical energy.

He pointed out that through the efforts of the Commission, less densely populated parts of B.C. now have electrical service stimulating industrial and commercial growth.

Illustrating the company's power with a break-down Mr. McMordie said that the Commission's plant consists of six hydro-electric plants, totalling 239,000 kw.; one gas turbine plant, totalling 20,000 kw.; and 23 diesel electric plants, totalling 72,000 kw. Requirements for 1970 are expected to total 850,000 kw.

Mr. McMordie elaborated in considerable detail regarding the Homathko-Chilco scheme capable of providing 30,000 kw. of continuous firm power. If the full yield of Chilco Lake were used, that total would become 1,020,000 kw., he said.

Second well-attended meeting of the season was held recently when K. McKenzie and R. N. McLellan discussed the suspension type of river pipeline crossings.

Mr. McLellan covered very thoroughly the subject of mechanics of suspension while Mr. McKenzie presented the problems of anchorages, foundations and towers. Slides were shown.

WINNIPEG

C. S. Landon, M.E.I.C., *Sec.-Treas.*

Members of the Electrical Section heard an interesting paper entitled "Higher Utilization Voltage" delivered by Mr. S. Collins of the Canadian Westinghouse Co. Ltd. on November 7, 1957.

Mr. Collins stated that "The electric utility industry is faced today with the dilemma of reconciling three basic facts". His paper was built around these headings:

1. One hundred and twenty volt lamps and miscellaneous appliances by the millions sold over the counter every year—maintained by "do-it-yourself" home owners.
2. The 120/240 volt single phase distribution system has inherent economic limitations.
3. Central air conditioners and heat pumps are becoming more popular and their integral hp motors practically demand three phase service.

W. R. C. Taylor, M.E.I.C., presented a most interesting paper to the Branch on the subject of structural precast and prestressed concrete on November 21.

Mr. Taylor dealt at length with the advantages to be derived from the use of precast and prestressed concrete, enumerating some of the disadvantages.

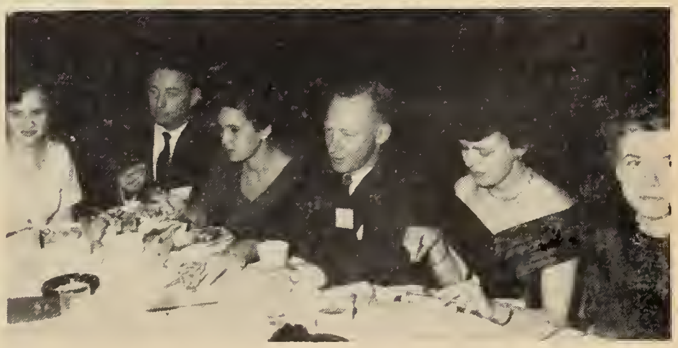
The lecture was illustrated by a series of slides and coloured films in which were shown many of the projects undertaken by Mr. Taylor's company and the differing methods of construction employed was shown.

Electrical Section Dance

The Electrical Section annual dinner and dance was held in the Marlborough Hotel, November 15, 1957. Attendance at this year's function was reduced considerably from previous years. However, the ensuing informality was enjoyed.

The 1957 edition of the dance served as a commemoration of the 50th anniversary of the founding of the Winnipeg Branch of the E.I.C. Dr. C. S. Landon spoke on behalf of the Branch.

The Toronto Branch enjoyed a Ladies' Night on November 15, 1957 at the Boulevard Club, Toronto. Of the 315 assembled members and guests, a few are shown here. At lower left (beginning second from left) are: E. R. Davis, Toronto Branch chairman; Mrs. Roy Brown and Roy Brown, chairman of the Toronto Branch A.I.E.E. The gentleman at the extreme left was not identified.
The photo at lower right shows Gordon Norton, and guests during the dinner.



News of Other Societies

Mining and Metallurgical Congress

The Sixth Commonwealth Mining and Metallurgical Congress, 1957, having taken the form of an extensive tour of Canada, concluded in Halifax in October. The Canadian Institute of Mining and Metallurgy was host for the sixth Congress, whose nearly 500 registered delegates represented 35 countries.

The seventh congress will be in 1961, in South Africa.

Dr. R. W. Diamond, M.E.I.C., of Trail B.C., president of the Sixth Congress, in his official address, discussed generally the non-ferrous metal business, and particularly the shortage of engineers and scientists in the mineral industries.

The C.I.M. reported the Sixth Congress in September, October and November issues of the *Canadian Mining and Metallurgical Bulletin*, publishing Dr. Diamond's address in full.

The tour was reported to be a success. An impressive array of mineral developments was offered for inspection. Various rail and air tours leaving Vancouver September 11, permitted inspection of mining at Trail and Kimberly, coal mining operations in the Crow's Nest Pass area, a chemical metallurgical plant at Fort Saskatchewan and various petrochemical plants in the vicinity of Edmonton. A group inspected shaft sinking practices for potash mining at Unity, Sask. A northern aerial tour visited Kitimat, Whitehorse, Mayo, Dawson, Yellowknife, Uranium City, Flin Flon, Lynn Lake.

From Winnipeg the party proceeded through Steep Rock, Sudbury, Sault Ste. Marie, Blind River, and the gold mining fields of northern Ontario. There were visits to Timmins, Kirkland Lake, Noranda-Rouyn, and the Val d'Or-Malartic areas. In Toronto, Hamilton and Niagara Falls the industrial areas of Ontario were seen.

The delegates were entertained in Ottawa, Montreal and Quebec City. They toured the St. Lawrence Seaway, and travelled in parties to Asbestos, Thetford Mines, and Knob Lake. From Moncton, one group flew to Newfoundland to study operations at Wabana and Buchans. Mining developments in New Brunswick were observed, and mining and industrial plants of the Sydney and Halifax area.

To commemorate the Sixth Congress a series of volumes devoted to various phases of the exploration, development, production, and beneficiation of Canadian mineral resources have been prepared by the Technical Division of C.I.M. Information about these volumes appears on Page 536 of the *Canadian Mining and Metallurgical Bulletin*, September, 1957.

Housing Conference

A two-day top level conference held November 14-15, 1957 at Ottawa and sponsored by the Canadian Construction Association discussed ways and means of increasing the opportunities of home ownership among those earning less than $5000 a year.

Honourable Howard Green, Federal Minister of Public Works, guest speaker, said that the special interest of the Federal Government in low-cost homes was the reason for the introduction of the $150 million agency loan program last August.

From statements made, and conclusions reached at the conference it was concluded the present main housing lack was in the lower cost field.

The present relative shortage of investment funds was such that in general the easing of down payments and other financial arrangements making more people eligible for N.H.A. loans would not lead to an appreciable increase in the number of units built.

Unless public funds in some form are again made available to supplement private resources it is indicated that housing starts in 1958 will be less than achieved in 1957.

The construction industry is technically capable of producing low-cost homes. The main reasons why more low-cost homes are not being built are largely factors beyond the industry's control—marketability of low-cost units and availability of serviced land, etc.

Delegates were of the opinion that the land cost and availability factors were in general more of a problem than actual construction costs. Land prices for N.H.A. housing doubled, 1951-56, whereas the construction cost per square foot increased by only a fifth. In most large cities the relative shortage of serviced land and the problems of "urban sprawl" meant that greater emphasis would have to be given to apartment blocks, row housing and semi-detached houses than had been the case in recent years.

One of the main problems in connection with the servicing of land is the provision of feeder watermains and trunk sewers. A resolution was adopted advocating that the National Housing Act be amended so as to provide for the financing of these facilities in lower cost housing areas and make them available to builders.

The Canadian Construction Association was requested to sponsor another similar conference next spring.

CALENDAR

American Concrete Institute

The Annual Convention of the American Concrete Institute will be held February 24-27, 1958 at the Morrison Hotel, Chicago. The fifty-fourth meeting of the A.C.I. will encompass many varied discussions on the technical aspects of concrete and concrete construction.

Address of the Institute is: P.O. Box 4754, Redford Station, Detroit 19, Michigan.

Welding Conference

The Fourth Annual Midwest Welding Conference will be held in Chicago on January 29 and 30, 1958. The conference will be held in the Illinois Technical Chemistry Building, 3255 Dearborn Street, Chicago.

Inquiries concerning the conference should be sent to the conference chairamn, Harry Schwartzbart, Supervisor of Welding Research, Armour Research Foundation, 10 W. 35th St., Chicago, 16.

Library Notes

Additions to the Institute Library

Reviews, Book Notes

Standards

BOOK NOTES

Prepared by the Library, The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

AIRCRAFT HYDRAULICS: V. 2 COMPONENT DESIGN

The second of a series of textbooks on aircraft hydraulics sponsored by the Royal Aeronautical Society, this volume deals with component design including seals, pumps and motors, jacks, selectors, valves, piping and servo-controls. The authors of the different chapters are all experts in their own fields. There are many illustrations.

The first volume covered hydraulic systems, fluids, hydraulic theory, general system problems and circuits, and system installation and testing. The third volume will cover the design of landing gear. (Ed. by H. G. Conway. Toronto, Ryerson, 1957. 198p., $9.00.)

*BANDSTRASSEN IM BAUBETRIEB

Conveyor belt lines in the construction industry are treated in this practical text book. Part 1 describes the equipment in detail and covers its selection and use, including supporting structures, drives, and auxiliary equipment. Part 2 deals with the cost aspects; dimensioning the plant, cost of equipment, cost of operation; and maintenance costs. The information given is based on extensive practical experience. (H. Eckert. Berlin, Springer-Verlag, 1957. 201p., DM 37.50).

Members may borrow the books mentioned in these Notes on application to the librarian. Two books may be borrowed for two weeks.

LIBRARY HOURS

Monday to Friday

9 a.m. — 5 p.m.

Saturday

9 a.m. — 12 noon

*CATALYSIS IN PRACTICE

Seven papers by practicing engineers for practicing engineers make up this small volume. Presented in simple, direct language the papers describe how to select a suitable catalyst for a proposed process, the commercial preparation of industrial catalysts, fixed bed moving bed catalyst systems, the economics of catalyst use, operating problems, and trends and prospects in catalysis. A handy guide for anyone concerned with the chemical process industries. The papers were originally presented at a conference sponsored by the American Institute of Chemical Engineers, Philadelphia-Wilmington Section and the University of Pennsylvania School of Chemical Engineering. (C. H. Collier. New York, Reinhold, 1957. 153p., $3.95)

THE EARTH CHANGERS

The story of the United States heavy construction industry in the twentieth century, from the building of the Hoover Dam to the present, this book is concerned chiefly with the Utah Construction Company, Morrison-Knudsen, Bechtel, Kaiser, and Perini-Walsh.

It is an exciting history of the building of dams, bridges, tunnels and roads, and of the men who built them, both in the United States and abroad. (N. C. Wilson and F. J. Taylor. Toronto, Doubleday, 1957. 312p., $5.75.)

EFFECTIVE INDUSTRIAL MANAGEMENT

Intended to be used as a textbook in an introductory course in industrial engineering and management, this book not only describes the functions and duties of management, but also emphasizes the basic procedures involved. The author has tried to show the advantages and limitations of current managerial techniques, policies and practices, and how these may be changed when necessary.

Among the topics covered are: the growth of modern management; accounting fundamentals, business finance, etc.; plant location; product development; methods analysis and work measurement; plant layout; materials handling; purchasing and inventory; production and quality control; and labour.

Bibliographies are included at the end of each chapter of this book which should prove useful both to students and to those wishing to obtain a general picture of the field of management. (J. L. Lundy. Toronto, Brett-Macmillan, 1957. 588p., $6.90.)

*ENGINEERING METALLURGY

This is a concise, up-to-date, and authoritative presentation of the essentials of the subject, useful to all engineers, student and practicing. Produced by a group of 40 professors actually engaged in teaching metallurgy, the book deals in chapters 1 through 6 with general principles as related to engineering, 7 through 10 with nonferrous metals, and 11 through 20 with iron and steel. Machinability, corrosion, and the effects of temperature are covered in the last three chapters. The text is liberally illustrated with photographs and drawings, and sets of exercises and problems are provided at the end of each chapter. (By the Committee on Metallurgy. Toronto, Pitman, 1957. 516p., $7.50.)

ENGINEERING SURVEYS: ELEMENTARY
ENGINEERING SURVEYS: ELEMENTARY AND APPLIED

The first of these volume is intended for an elementary course in surveying and the second, combined, volume for more advanced students.

The first eighteen chapters are included in both books and cover measurement of distance; compass surveying; leveling; the transit; instruments; observations for meridian; stadia surveying; topography; triangulation; land, area, route and city surveys, and the organization of surveys.

Part two, found only in the second volume deals with such topics as horizontal and vertical control; engineering astronomy; topography; photogrammetry; map projection; hydrographic surveying; legal principles of boundary surveying; city planning, underground and construction surveys.

Both volumes contain mathematical and other tables. These are, of course, well-known texts, this being a 1955 print-

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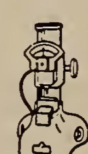

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ing of the latest edition. (Harry Rubey, G. E. Lommel and M. W. Todd. Toronto, Brett-Macmillan, 1955. 2vols $5.00 and $7.00.)

ENGINEERING THERMODYNAMICS, WORK AND HEAT TRANSFER

Intended for students up to the standard of a British honours degree this volume covers the fundamentals of applied thermodynamics.

The first part of the book deals with the principles of thermodynamics without referring to the behaviour of particular substances. Part 2 deals with the properties of fluids, and applies the principles already discussed to open and closed systems. This section also covers gas and vapour mixtures and combustion processes. The third and fourth parts cover work and heat transfer. Worked examples and problems are included and there is a list of references for further study.

The authors are lecturers in mechanical engineering at the University of Bristol. (G. F. C. Rogers and Y. R. Mayhew, Toronto, Longmans Green, 1957. 619p., $9.00.)

FRANCE EXPORTATION: FRENCH DIRECTORY FOR INTERNATIONAL TRADE

A trade directory with a difference, this volume, the French "Annuaire Bleu", not only lists manufacturers and producers of various products, but also gives a brief description of each industry and locates the main centres of the industry on a map of France.

The industries covered are: food and agriculture; wine; construction; pottery and glass; leather; textiles; clothing; chemical and pharmaceutical; mining; iron and steel; mechanical engineering; precision and optical instruments; electrical; automobile; aeronautical; paper; perfume; jewellery. There are also sections on insurance and banking; travel and the tourist trade, and foreign trade.

Invaluable for those interested in purchasing anything from France. (Paris, Centre d'Expansion Francaise, 1957. 623p.)

FRICTION, LUBRICANTS AND CUTTING FLUIDS

A chapter reprinted from Modern Workshop Technology, this useful monograph covers the theory of lubrication; types of lubricants, their care, handling and properties; lubrication of machine tools; and cutting fluids. There is a list of references for further reading. (I. S. Morton and A. L. H. Perry. London, Cleaver-Hume Press, 1957. 41p., 3/6.)

HIGH FIDELITY SIMPLIFIED, 3RD ED.

Written primarily for the amateur enthusiast this volume contains all the information required for the installation and operation of a high fidelity set. The theory behind high fidelity reproduction is explained, and the various parts of the set are covered, including the loudspeaker, the amplifier, the record player and the tuner. Tape recorders are also discussed.

The text of this third edition has been revised, mention of older models removed, and new ones included. (H. D. Weiler. New York, Rider, Toronto, Pointon, 1957. 202p., $2.50.)

IDEAS, INVENTIONS AND PATENTS; HOW TO DEVELOP AND PROTECT THEM

The author's main purpose in writing this book was to help engineers, scientists and management to obtain a better understanding of patents. He points out that much information on current technological developments can be gained from patent literature, and that more use could be made of it.

He explains the principles underlying patents in all fields of engineering, outlining exactly what patents are and their purpose, and what inventions are patentable. He discusses the records which should be kept for patent protection, and the important role played by the patent attorney. Also covered are the steps which must be taken before a patent can be granted; the procedure followed by the patent office; interference; licenses, assignments and shop-rights; understanding patent claims and infringements; trade secrets and confidential disclosures; designs, copyrights and trademarks. The Appendix includes representative forms of an approved engineers' agreement to assign inventions, a form of assignment and copies of the necessary formal papers.

The author, a graduate electrical engineer, is a practicing patent attorney. (R. A. Buckles. New York, Wiley, 1957. 270p., $5.95.)

METALS AND MEN: THE STORY OF CANADIAN MINING

Already well-known for his books about Canada, Mr. LeBourdais here turns his attention to the fascinating and often exciting story of Canadian mining.

As the author points out in his foreword "Canadian mining has advanced across the continent against the sun in a series of booms." He begins his story with the gold rush into the Cariboo a hundred years ago, and follows the eastward course of mining development to the latest expansion into New Quebec and Labrador.

All the names which have meant so much in Canada's development are here, the Klondike, Sudbury, Cobalt, Porcupine, Kirkland Lake, Rouyn, Noranda, Haileybury, Falconbridge, Asbestos, Steep Rock, Knob Lake and Elorado. The emphasis throughout is on discovery and development, on the men who did the prospecting and on those who had the vision, and the money, to bring the finds into production. There are many photographs in black and white and colour, as well as some excellent maps.

Mr. LeBourdais has spent many years collecting the material for this book, and has himself visited many of the mines of which he writes. (D. M. LeBourdais. Toronto, McClelland and Stewart, 1957. 416p., $8.50.)

MINERALS: CANADA AND THE WORLD

The remarkable growth of the Canadian mineral industry in the last thirty years is shown in this publication which deals with some thirty-five metals, non-metals and mineral fuels produced in this country. During this period the value of the Canadian mineral production rose from $240 million to over $2 billion.

For each mineral information is given on Canadian and world production, Canadian exports and the imports of other countries. The material is presented in the form of Canadian and world maps, graphs and charts, and the location of Canadian producers and potential production is shown.

The maps, charts, etc. have been prepared from official statistics which are reproduced in a supplementary volume. (Canada, Dept. of Mines and Technical Surveys. Ottawa, Queen's Printer, 1957. 2 vols., spiral binding, $1.00. Mines Branch report No. 860.)

NATIONAL DIRECTORY OF THE CANADIAN PULP AND PAPER INDUSTRIES

The main part of this Directory is devoted to a listing of Canadian pulp and paper companies arranged by province. The information given for each company includes: location of head office and mills; rail and steamship connections; officers; chief personnel; timber supply; production; specialties; equipment; power supply.

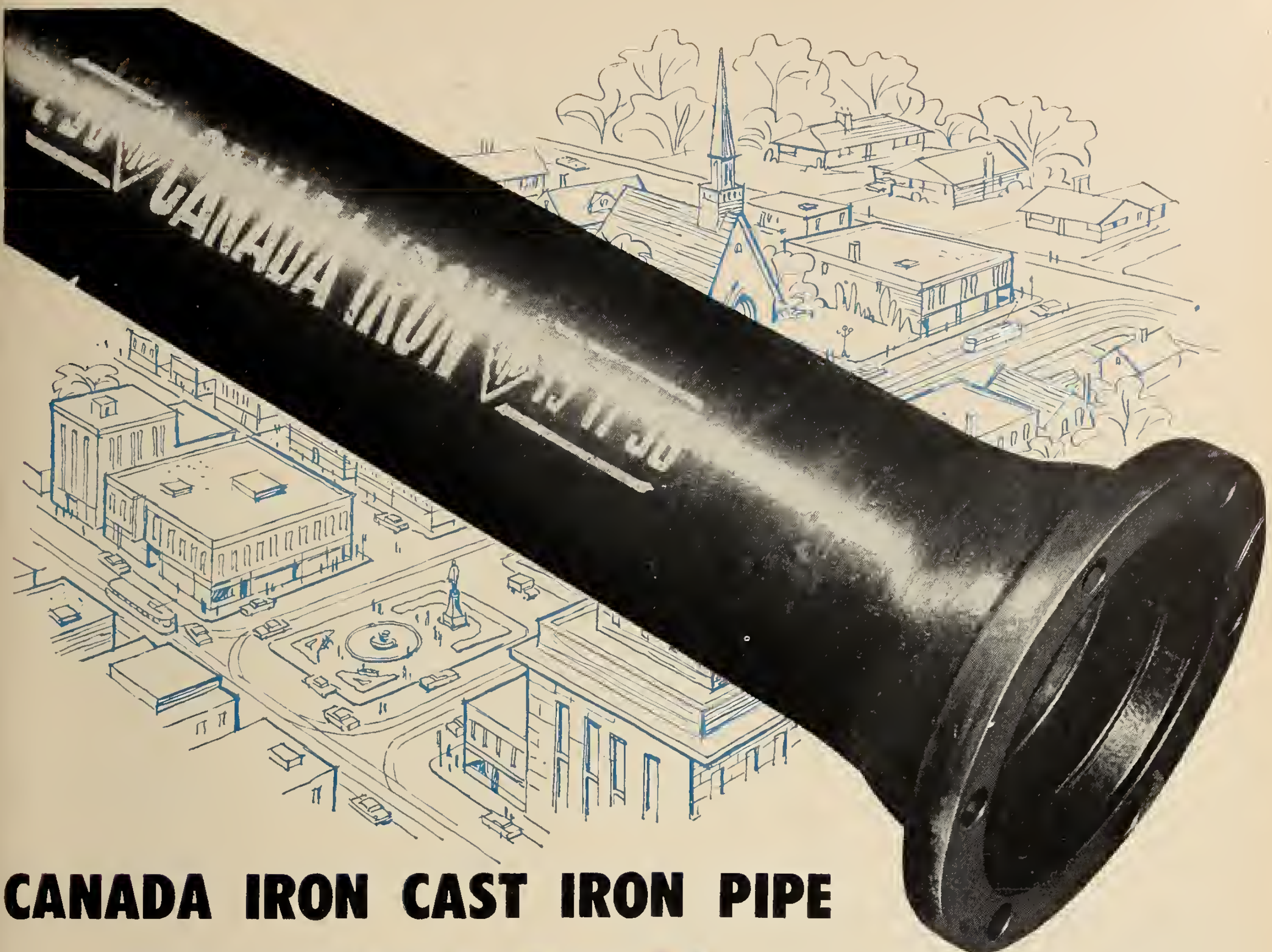
Preliminary figures are given for 1956 production and exports, and there are surveys of the pulp and paper, paper box and bag and roofing paper industries in 1955. There are lists of converters of paper, pulp and paper distributors, paper merchants, pulp and paper mills classified by product; manufacturers of paper products, and organizations connected with the industry.

This is a most useful publication. (Ed. by J. N. Stephenson. Gardenvale, National Business Publications, 1957. 534p., $5.00.)

PROFILE OF THE ENGINEER

The first in a series of projected reports of a "Comprehensive Study of Research Relating to the Engineer" undertaken by Deutsch and Shea, the purpose of this Profile is to examine the personality traits, interests, intelligence and abilities of engineers. The report is based on various earlier studies made of engineers and their profession, and these are listed in the bibliographies for those who wish to pursue the analysis further, or from a different angle.

The general conclusion, our readers will be pleased to learn, is that engineers are above-average in intelligence, and take an all-absorbing interest in their work. They tend, however, to have rather narrow fields of interest, and to be tense and unstable. This we are sure,



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will be a hotly debated point, as will be many of the other findings.

The series was undertaken because of the growing importance of engineering in today's society, and the need to know something of the men who design and run the machines which form the basis of that society.

This should prove a most popular report. (Deutsch and Shea. New York, Industrial Relations News, 1957. 3 parts.)

THE PROTEROZOIC IN CANADA

Proterozoic rocks include those Precambrian which are the least deformed and metamorphosed, and the Proterozoic time produced in Canada much of great interest to geologists and of great economic importance. It is probable that at that period were formed the iron deposits of the Lake Superior district, the Michigan copper deposits, the Sudbury nickel-copper-platinum deposits, Cobalt silver and the uranium deposits, of the Canadian Shield. This period was also responsible for the Sullivan zinc-lead-silver deposits.

Many of these areas have been studied intensively, and the findings are summarized in this volume.

The first papers cover the Proterozoic in Canada, and its dating, and the forms of life found in that era. The second and largest group of papers deals with the Proterozoic rocks in the Canadian Shield, each paper covering one particular area. The remaining papers discuss the various other areas in Canada where these rocks are found.

This symposium and an earlier one on the Grenville Problem present the views of active workers in the Precambrian. (Ed. by J. E. Gill. Toronto, University Press, 1957. 191p., $5.95. Royal Society of Canada Special Publication no. 2.)

*ROADS, RAILS AND WATERWAYS

This non-technical account of the activities of the Engineer Department of the United States War Department in the exploration of the country and in the construction of roads, waterways, lighthouses and other public works from 1815 to the Civil War will interest students of economic and military history and the history of transportation. Extensive bibliographical references are included. (F. G. Hill. Norman, University of Oklahoma Press, Toronto, Burns and MacEachran, 1957. 248p., $5.25.)

*ROUTE-MAPPING AND POSITION-LOCATING IN UNEXPLORED REGIONS

Ground route-mapping as distinguished from that making full use of photogrammetry is the main subject of this book. The two principle parts of the book are given over to a method of route-mapping and to position-finding and altitude measurements. The third part takes account of photography as an aid in route-mapping and topographical surveys. Each part has its own author, who is an expert in his field. (W. Filchner, E. Przybyllok and T. Hagen. New York, Academic Press, 1957. 288p., $9.00.)

*SIXTH SYMPOSIUM (INTERNATIONAL) ON COMBUSTION

This sixth symposium was held at Yale University in August 1956, and was sponsored by the Combustion Institute. The principle subjects covered in this collection of 129 papers are: structure and propagation of laminar flames; structure and properties of turbulent flames; high speed reactions; flame stabilization in fast streams; instability in combustion chambers; combustion of solid fuels; combustion of explosives and solid propellants; evaporation and combustion of droplets and sprays; experimental and analytical techniques; and applications. The volume as a whole is an important source of information on recent advances in the combustion field. (New York, Reinhold, 1957. 943p., $28.00.)

SOLAR CONTROL AND SHADING DEVICES

Although there is a tendency to think that solar control is a problem which has only to be faced in hot climates, this is incorrect for, as the authors point out,

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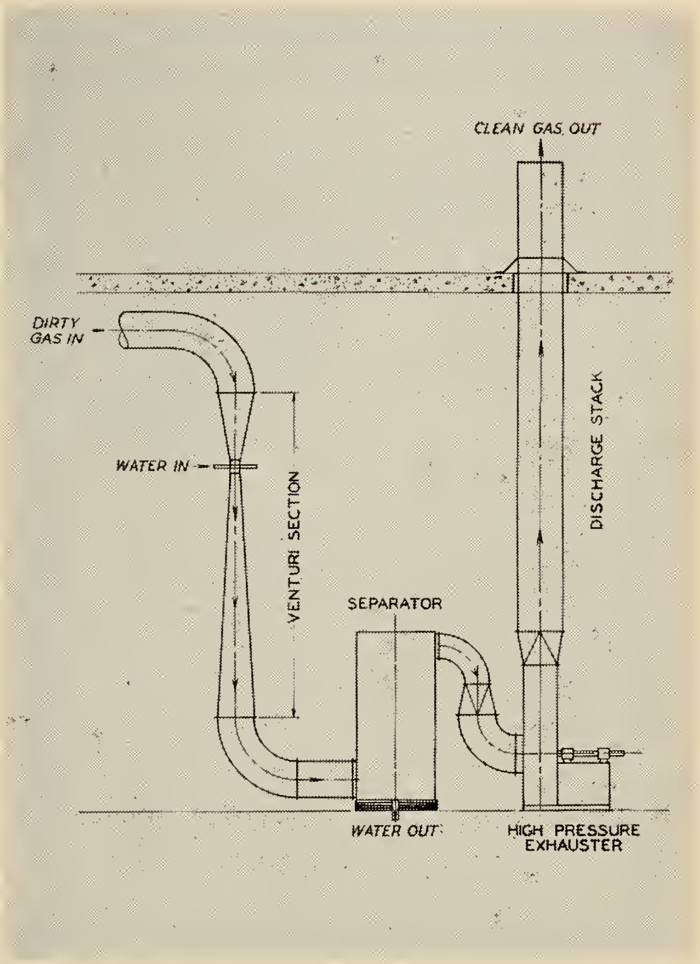

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CANADIAN LICENSEE FOR PEASE ANTHONY EQUIPMENT the real idea behind solar control is to let the sun's heat energy into buildings in cool weather, and exclude it in hot.

The authors, who are at present teaching and doing research at Princeton School of Architecture, have had much experience in designing apartment houses, hotels, factories, exhibition buildings, etc.

The first part of the book deals with the role of shading devices as architectural elements and the technical considerations in the design of solar protection, including such factors as climate, the movement of the earth, solar and standard time, shading effects of trees, buildings, etc.

The practical application of shading methods is discussed, and a final section contains over one hundred examples of buildings by many different architects in all parts of the world where solar control devices have been incorporated. The photographs, as might be expected, are excellent, and there is a list of references for further reading. (A. and V. G. Olgyay. Princeton, University Press, Toronto, Saunders, 1957. 201p., $14.40.)

THE STATESMAN'S YEAR-BOOK, 1957

This "statistical and historical annual of the states of the world" contains a wealth of information, obtained in many cases from official sources. The first section deals with the United Nations and other international organizations.

Other sections cover the British Commonwealth, country by country, the United States, and other countries of the world. The information given for each country includes type of government, constitution, area, population, religion, education, justice, social welfare, finance, national defence, commerce, communications, national income, banking, and diplomatic representatives. For each country a list of reference books is given.

This is a most useful volume. Most of the information it contains is correct to the end of 1956, although some of the statistics are for 1955 or earlier. (Ed. by S. H. Steinberg. Toronto, Macmillan, 1957. 1638p., $8.50.)

STEREOPHONIC SOUND

All hi-fi enthusiasts, and those interested in the mechanics behind the vast quantities of sound heard in movie houses these days, will welcome the advent of this book which explains the theory of stereophonic sound, which, incidentally, was first demonstrated in 1881.

It covers such systems as binaural, two and three-channel stereophonic, stereosonic, and coded-stereophonic and also their use with radio, disc recordings, tape, etc. Also discussed are the systems available, and those likely to become available. (N. H. Crowhurst. New York, Rider, Toronto, Pointon, 1957. 118p., $2.25.)

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***SYMPOSIUM ON FULL SCALE TESTS ON HOUSE STRUCTURES**

The included papers cover tests on houses built of plywood stressed-cover panels, on prefabricated buildings, and on pre-cast multi-story flat construction. There is also a report on a structural test of a house under simulated wind and snow loads. (Philadelphia, American Society for Testing Materials, 1957. 60p., $2.50. (ASTM stp. no. 210.))

SYMPOSIUM ON INTERNAL COMBUSTION ENGINE VALVES

The fourteen papers in this volume are all by members of the firm of Thompson Products Inc., and were originally read at technical meetings or appeared in industrial publications, and are now unavailable elsewhere. The papers deal with the internal combustion engine valve, and all those interested in the subject will appreciate the generosity of the firm in making these papers available. (Cleveland, Thompson Products, Inc., 1957. 216p.)

***SYMOPSIUM ON RADIATION EFFECTS ON MATERIALS, V.1**

The first of a series of symposiums on this subject, sponsored jointly by ASTM and the Atomic Industrial Forum. The sixteen papers included deal with theory, radiation facilities and mechanics of testing, and with experimental work both on fuel and graphite materials and structural materials. Radiation effects on plastics, organic materials, plain-carbon steels, and copper-iron alloys are discussed. (Philadelphia, American Society for Testing Materials, 1957. 190p., $4.75. (ASTM stp. no. 208.))

***SYMPOSIUM ON: SEISMIC AND SHOCK LOADING, GLUED, LAMINATED AND OTHER CONSTRUCTIONS**

Three of the papers in this combined publication deal with building design for lateral forces and with the results of laboratory tests on full-size wooden structural elements particularly with reference to lateral shock resistance. The other five papers report on the development of glued-laminated, stressed-skin, and sandwich constructions with wood as the material. Technical information is also included on factors affecting the characteristics and properties of wood. (Philadelphia, American Society for Testing Materials, 1957. 85p., $2.75. (ASTM stp. no. 209.))

***SYMPOSIUM ON STRUCTURAL SANDWICH CONSTRUCTIONS, 1956**

This symposium includes two papers on adhesive bonds, including metal-to-metal and metal-to-resin adhesion, and two papers on high-temperature testing. Other papers deal with sandwich in the design of helicopters, materials for architectural panels, non-destructive testing of sandwich structures, and shear strength of aluminum honeycomb. (Philadelphia, American Society for Testing Materials, 1957. 103p., $2.75. (ASTM stp. no. 201.))

***SYMPOSIUM ON VAPOR PHASE OXIDATION OF GASOLINE, 1956**

Four papers as follows: Fuel factors influencing deposits in intake portio nof fuel systems of gasoline engines; Induction system gum: Engine versus bench test; Test method for studying the effect of fuel composition upon intake valve deposit forming characteristics; Effects of inhibition and envronment on the induction system oxidation of gasoline. (Philadelphia, American Society for Testing Materials, 1957. 68p., $2.50. (A.S.T.M. stp. no. 202))

THERMODYNAMICS OF HEAT-POWER SYSTEMS

The author has arranged this treatment of thermodynamics in the way in which he has taught the subject for the last twenty years, the basic concept being that of thermodynamics as the study of energy from source to utilization. He has emphasized general ideas rather than technical explanations, mathematical derivations, etc., which he believes are better covered in the classroom. He has included references for further reading, both for those wishing to examine the subject from a different point of view, and for those wishing to go more deeply into any topic.

The first two sections of the book discuss energy sources, and the major forms of stored energy—atomic, molecular and mechanical. Following this is a discussion of the liberation of energy, and a detailed coverage of energy in transition, that is, heat and work. The next three chapters present energy equations for nonflow and flow processes, and flow-to-nonflow processes. The final sections deal with the transportation of energy in gases, vapours and gas-vapour mixtures, and with its utilization in the different heat-power systems. (F. W. Hutchinson. Cambridge, Addison-Wesley, Toronto, Allen, 1957. 490 p. $8.50.)

*TELECOMMUNICATIONS

The main emphasis in this comprehensive, introductory textbook is on the basic principles of communication engineering in modern practice, and although intended for engineering students, the text should be of interest to practising engineers who are interested in the field.

Following a brief historical introduction, the author covers such topics as networks, circuit, transmission lines, attenuators and filters, valves, amplifiers, modulation, microphones, telephony, telegraphy, radio wave propagation, etc. References for further reading and problems taken from University of London and other examination papers are included.

The author is a lecturer in electrical engineering at the University of London. (W. Fraser. London, MacDonald, 1957. 772p., £3.5.0.)

SOVIET EDUCATION FOR SCIENCE AND TECHNOLOGY

With the interest in Soviet technology and education at an all-time high, the publication of this report will be of interest to many people. The book is the outcome of a project begun by the M.I.T. Center for International Studies in 1953 as part of its study of Soviet society. The author is on the staff of the Center.

In this book Mr. Korol examines in a general outline the Soviet educational system from elementary to graduate schools, and then considers in greater detail training in physics and mechanical engineering. Some references are made to the American system, but this is not intended to be a comparative study.

In the first chapter the general organization of education through the secondary level is outlined, and the alternatives to academic training mentioned. The next two chapters discuss the ten-year school, the equivalent of elementary and high school, its curriculum, intruction, textbooks and examinations. This is followed by a chapter on technical schools.

The greater part of the book is devoted to higher education, at both the undergraduate and graduate levels, with the curricula in physics and a typical major in mechanical engineering given in full, compared with their nearest equivalents at M.I.T.

In a final chapter the author presents his own opinions of Soviet education and American education. This is a most timely and thought-provoking report. (A. G. Korol. New York, Wiley, 1957. 513p., $8.50.)

URANIUM IN SOUTH AFRICA 1946-1956

This is the record of the development of the production of uranium in South Africa. It is the story of an industry which has had a phenomenal growth from its beginnings in 1946 to the present when some twenty million tons of gold ore residues are processed each year.

The Symposium at which these thirty papers were presented was organized by five South African Societies: South African Institute of Mining and Metallurgy; South African Chemical Institute; Institution of Chemical Engineers, South African Branch; Geological Society of South Africa; South African Institution of Mechanical Engineers. The societies are to be congratulated on organizing and publishing this Symposium.

There is an historical review of the developments leading to the construction of plants for the recovery of uranium from ore residues, and other topics covered include the occurrence and origin of gold and radio-active minerals in the Witwatersrand System; the determination of uranium; design and construction of uranium plants; leaching and ion exchange processes used; and other subjects related to the recovery of uranium.

Canada, the United States, and the United Kingdom all assisted in the development of this industry, although the majority of technical personnel were South Africans. Actual production began in 1953. (Johannesburg, South African Institute of Mechanical Engineers, 1957. 2 vols., $20.00.)

URBAN MOTORWAYS

"Traffic stagnation threatens most major cities in the world."

This volume reports the proceedings of the London International Conference which was organized by the British Road Federation in 1956 to discuss the problem as it applied to Britain, to see how the provision of urban motorways might help the situation, and to learn the steps being taken in other countries where the problem is being met.

Engineers from some thirty-two countries attended the conference which was called at the time a "Highway UNO" The various sessions discussed: the definition of an urban motorway and its value; the need for them in Great Britain and other countries; their economic justification; design aspects. One session was devoted to an open discussion, when comments were made by engineers from various countries illustrating their experiences.

This book is praactically a "must" for all those concerned with the urban traffic problem. (London, British Road Federation, 1957. 245p., £5.5.0.)

● BRIEFS

sales manager for controls and safety heads, Toronto area, for Black, Sivalls & Bryson Ltd.

Norton Company — The following appointments have been announced by the Norton Company of Canada Limited: G. W. Watts, manager, sales engineering; T. O. Charles, formerly Montreal district manager, to be general sales manager with headquarters in Hamilton Ontario; Robert E. Yule, JR.E.I.C., who was formerly district representative resident in Peterborough, Ontario, has been appointed Montreal district manager, with offices at 4920 Western Ave., Montreal; William D. Braun, formerly district representative in Toronto, has been appointed district representative Eastern and Northern Ontario with headquarters in Peterborough.

Canadian General Electric—I. A. Mayson has been appointed manager—marketing, electronic equipment and tube department, Canadian General Electric Company Limited, and G. S. MacDonell has been made manager—marketing, lamp department.

Canada — U. S. Chemical Engineering Conference

More than 750 engineers and executives are expected to attend a Canada-United States chemical engineering conference to be held in Montreal 20-23 April, 1958. The meeting is sponsored jointly by the American Institute of Chemical Engineers and the Chemical Institute of Canada, Chemical Engineering Division.

In addition to some 40 technical papers, to be delivered in a number of symposia on some of the latest developments and problems in industry, the program includes:

- A review of the European chemical industry by speakers from the Soviet Union, the United Kingdom, France, West Germany and Italy.
- A panel discussion on chemical engineering education in Canada and the U.S. with Dr. Walter G. Whitman of M.I.T. as moderator and three university professors representing each country.
- A panel discussion on the relationships between investors and the chemical industry management with Dr. C. F. Prutton, executive vice-president, Food Machinery and Chemical Corp., New York, as moderator and two industry executives representing each country.

Luncheon speakers include Lester B. Pearson, former Canadian external affairs minister and 1957 Nobel Prize winner, and W. M. V. Ash, president, Shell Oil Company of Canada. Plant visits arranged include an aerial tour of the St. Lawrence Seaway project, visits to the Industrial Cellulose Research Division of the Canadian International Paper Company at Hawkesbury, Ont.; Du Pont of Canada's integrated data processing centre in Montreal; the new Canadian Petrofina refinery in Montreal East; Quebec Iron and Titanium Company, Sorel, Que.; Canadian Titanium Pigment Company, Varennes, Que.; and the new facilities of the Pulp and Paper Research Institute of Canada, Pointe Claire, Que.

The technical symposia, each of four papers, include:

Statistics in Chemical Engineering (Dr. J. C. Whitwell, Princeton, chairman);

Chemical Engineering Problems in Heavy Water Reactors (Drs. D. Stewart, Atomic Energy Commission, Washington, and W. M. Campbell, Atomic Energy Commission of Canada, Chalk River, Ont., co-chairman).

Chemical Engineering in Mineral Processing (Dr. F. A. Forward, University of British Columbia);

High Temperature Materials for Jets and Rockets (Dr. C. J. Marcel, New York University);

Fluid Mechanics (two sessions — Drs. S. G. Mason and W. H. Gauvin, McGill and the Pulp and Paper Research Institute);

Noise in the Chemical Industry (Dr. G. Thiessen, National Research Council, Ottawa);

Future Sources of Energy (Dr. J. W. Hodgins, McMaster Univ.);

Chemical Engineering in the Pulp and Paper Industry (Dr. L. R. Thiesmeyer, Pulp and Paper Research Institute);

Modern Engineering Construction Techniques (S. A. Guerrieri, Lummus Company, New York).

In addition, there will be two sessions of general technical papers, one under the chairmanship of Dr. H. G. Donnelly, of Wayne State Univ., Detroit, and the other under Dr. K. O. Beatty, Jr., North Carolina State College, Raleigh, N.C., in which representatives of both industry and education will participate.

The two sessions of general technical papers will include topics ranging from "High purity tonnage oxygen for the steel industry" and "Operational control of continuous distillation plants", to "Turbulent heat transfer to Newtonian fluids of high Prandtl number".

Participants in the program come from 24 different universities in Canada and the U.S., and 30 different companies and research agencies. Universities represented are: British Columbia, Alberta, Toronto, McMaster, McGill, Laval, Queen's, Moscow, Frankfurt, M.I.T., Princeton, Delaware, Buffalo, New York, Cincinnati, Wayne, Illinois Institute of Technology, Purdue, Wisconsin, Southern Methodist, North Carolina State, West Virginia, Michigan, and California.

Companies represented include Etablissements Kuhlmann, of Paris; Farbwerke Hoechst, of Frankfurt, West Germany; Shell Oil; Imperial Chemical Industries Limited, Great Britain; American Cynamid; E. I. du Pont de Nemours and Company; Shawinigan Chemicals; Canadian Industries Limited; Du Pont of Canada; Consolidated Mining and Smelting; International Nickel Company of Canada; Columbia Cellulose; Carbide Chemical Company; L'Aire Liquide; Sherritt Gordon; Haveg Industries; Titanium Metals Corp.; Food Machinery and Chemical Corp.; Rysdon Products; Lockheed Aircraft; Lummus Company; Computer Usage Company; Fluor Corporation; Combustion Engineering; Foster Wheeler Corp.; Dow Chemical; Ohio Oil Company; Antibiotics S.A.; American Standard (Atomic Energy Division); and Kaiser Engineers.

Members of the National Research Council, the Pulp and Paper Research Institute of Canada, the Atomic Energy Commission of Canada, the U.S. Atomic Energy Commission, and the Battelle Memorial Institute are prominent on the program.

ANNUAL DINNER - DANCE

Senior Section, Montreal Branch
Windsor Hotel, Montreal

21 February 1958

Dinner 7.30 p.m. — **Tickets $5.00 a person**
Dance (two orchestras) — **$5.00 a couple**

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MEMBERSHIP

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MEET THE AUTHORS


Capital Press Service

C. R. Crocker, M.E.I.C. Senior Research Officer, National Research Council, Ottawa. *(Winter Construction).* Graduated from University of New Brunswick with degrees in electrical and civil engineering; worked with the New Brunswick Department of Highways and Federal Department of Mines and Resources. Served for five years overseas with the Royal Canadian Artillery; awarded the Distinguished Service Order. Joined the National Research Council in 1946, and in 1950 went to Division of Building Research; now head of the building practice (construction section).

J. T. Madill, M.E.I.C. Manager — Power Operations, B.C., Aluminum Company of Canada Limited, Kitimat, B.C. *(Installation and Operating Experiences with Kemano 2500-foot Head Impulse Turbines).* Graduated in electrical engineering from the University of Alberta in 1939 (B.Sc.), and in electrical engineering from the graduate school of M.I.T. in 1940 (M.Sc.). From 1941 until 1950 Mr. Madill was associated with the engineering, operating and maintenance of the Aluminum Company of Canada's 2½ million h.p. Saguenay system in the Province of Quebec. From 1950 until 1952 he was in the general purchasing department in Montreal supervising all electrical buying. In 1953 he was made manager of power operations for Alcan in B.C. As manager, power operations, B.C. he is responsible for Kemano, the reservoir operation, power transmission, Kitimat distribution, meteorological and hydrographic stations and records, and for the engineering of the Kemano expansion.

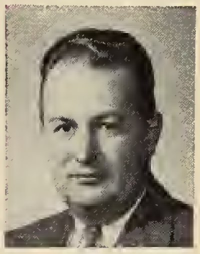
F. P. Gordon, JR.E.I.C. Assistant Superintendent — Power House and Transmission Lines, Aluminum Company of Canada Limited, Kemano. (Co-author, *Kemano Turbines.*) Joined the R.A.F. in 1939, leaving the service in 1945 as a Flight Engineer, after which he attended the University of British Columbia graduating in 1950 with a B.Sc. in mechanical engineering. He worked for Vancouver Iron Works Ltd. in their hydraulic turbine business and supervised the installation of the first Kemano turbines while with this company; he joined Alcan in 1954 as master mechanic for the Kemano power station.

H. F. Moore, Esso Research and Engineering Company, Linden, N.J. *(Automatic Computing for Process-Unit Operating Guides.)* Has been associated with oil refining since graduating from the University of Illinois in electrical engineering in 1928; his first job was with Lago Oil & Transport Company in Aruba, Netherlands West Indies. In 1934 Mr. Moore transferred to the central engineering organization of the Standard Oil Co. (N.J.) now part of Esso Research & Engineering Company; here his work has been in procurement, application, process design and engineering development, with the field of instruments, automatic control and analyzers always represented.

Four co-authors, Messrs. M. A. Scheil, G. E. Fratcher, S. L. Henry, and E. H. Uecker, all of the A. O. Smith Corporation, Milwaukee, Wis., contributed to the paper *Manufacture and Metallurgy of Flash-Welded Line Pipe.*

M. A. Scheil, Director, Metallurgical Research. Graduated from University of Wisconsin, (B.S. Chem. Eng. 1927, M.S. Metallurgy 1930). Mr. Scheil joined Gisholt Machine Company, Madison, Wis., as metallurgical chemist, 1927; in 1929 he joined A. O. Smith Corporation, Milwaukee, as metallurgist, became metallurgical engineer, in 1932, and has been director of metallurgical research since 1940. He is a prominent member of many technical societies, and active on several advisory committees on metallurgy.

G. E. Fratcher, Director of Engrg., Tubular and Process Div. Graduated from Marquette University (B. Mech. Eng. 1936) and joined A. O. Smith Corporation, Milwaukee, as design engineer; in 1944 he became chief product engineer, vessel division, in 1949 manager of research pressure vessel and tubular goods, in 1952 chief engineer of process equipment division and consulting engineer on tubular products, and has been in his present position since 1955.


G. E. Fratcher


S. L. Henry


E. H. Uecker

S. L. Henry, Asst. Dir., Metallurgical Research. Graduated from the University of North Dakota (B.S., Mech. Eng. 1934, post graduate study in metallurgy, 1936). Mr. Henry was instructor in mechanical engineering at the University of North Dakota, 1935-1936; was employed as metallurgical engineer at Fairbanks Morse & Co., 1936-1942; he joined A. O. Smith Corporation as metallurgical engineer in 1942, and in 1946 was appointed to his present position.

E. H. Uecker, Dir. of Quality in Oil Field Products and Ordnance. Mr. Uecker's training included courses in business, chemistry, and engineering and metallurgy. After employment with A. F. Westphal and Witmor and Gibbons between 1924 and 1926, he joined A. O. Smith Corporation in 1926 and was engaged on manufacturing, engineering and inspection. He became quality control supervisor in 1932 and in 1941 his present appointment was made.

COVER PICTURE

The forthcoming Southern Ontario Regional Conference will be held not far from the new Burlington Beach Skyway, which will eliminate a serious restriction in traffic on the Queen Elizabeth Highway near Hamilton, Ont. The cover picture shows part of the recently completed centre span which crosses the ship channel into Hamilton harbour.

Photo: Tom Bochsler

Winter Construction

C. R. Crocker, M.E.I.C.

Associate Research Officer, National Research Council, Ottawa, Ont.

Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June 1957

WINTERS IN CANADA are praised by many and cursed by many more. The severity of the weather varies from the mild damp regions of the Pacific coast to the harsh cold plains of the Prairie Provinces. But all regions in Canada have one thing in common—unemployment during the winter months. The construction industry is no exception to this general situation; in fact, the seasonal variation in employment in construction is greater than in any other major industry.

For Canada as a whole employment reaches a peak around the beginning of September, holds at a fairly high level through the fall, and then starts going downhill. This decline continues until about April when the seasonal upturn begins. What are the reasons for this annual variation in employment? The weather is, of course, one of the important factors. The Canadian farmer with the best will in the world cannot plant seed in February; Canadian seamen cannot sail the Great Lakes in mid-winter. There is another reason, however, for seasonal unemployment and that is customs and traditions like buying gifts at Christmas or new clothes at Easter (which is reflected in high employment in the retail trades) or starting to build a new house in the spring.

The most serious result of seasonal unemployment is the waste of manpower involved. Man-hours not used can never be regained. It is estimated that there are 250,000 Canadians seasonally unemployed each winter even in years of generally high employment. It is impossible to assess the actual cost of reduced output during the winter months, but in lost wages alone the figure would be many millions of dollars. Another important consideration is the annual cost of helping to maintain workers and their families who lost their jobs during the winter. In the months from December 1954 to April 1955 about $162,000,000 was paid out in unemployment insurance benefits, a large part of it to those seasonally unemployed. Unemployment affects all, because idle workers are not productive workers, and the loss in wages and purchasing power of those who are seasonally unemployed is felt by everyone.

Seasonal unemployment in the construction industry has been a national problem for only a relatively short time. Not long ago most construction work closed down in November and remained closed until April. Unemployment was not a serious problem because the good construction worker in summer became the top bush worker in winter. The construction industry has, however, undergone a "mechanical revolution" resulting in the development of many specialists to keep pace with the introduction of machines. These skilled men no longer find it easy to get another job when a construction project closes. In February 1957, 75,000 skilled construction workers were seeking employment. In fact, one-third of all unemployed at that time were skilled or unskilled construction workers. The profound effect of unemployment in the construction industry on the national economy is clearly evident.

The Federal Government has been vitally concerned with seasonal unemployment and in the past few years has been studying the problem in co-operation with employer and labour groups and with provincial governments. One of the results of the study made by the National Employment Committee was a recommendation to the Government that it should undertake a study of ways and means whereby the awarding of government contracts might be better timed to offset as much as possible the seasonal variations in construction activities.

In September 1955 in an address delivered before the Union of Nova Scotia Municipalities, the Minister of Public Works, the Honourable Robert Winters, announced the details of a Cabinet directive relating to winter construction. This directive ordered four specific steps to be taken in so far as they were practicable. These were:

(1) Government departments and agencies were to arrange their construction programs so that plans and specifications, tender calls, contract awards, and the various stages of actual construction would be timed to provide the maximum amount of winter work for the construction trades;

(2) alterations and repairs on buildings, houses and equipment owned by government agencies were to be planned so as to be carried out as far as practicable during the winter months;

(3) procurement programs were to be arranged where practicable to create the maximum amount of winter employment; and

(4) with the objective of keeping increased winter employment in mind, each department and agency concerned should, if necessary, adapt its financial arrangements, staffs, and other related matters in such a manner as to give effect to this directive.

Federal departments and agencies, although they spend sums running into hundreds of millions of dollars annually in the construction field, cannot alone solve the unemployment problem. The example already set by the Federal Government, if followed by governments at all levels and by private enterprise could really result in great progress.

In recognition of this fact, a Joint Committee on Wintertime Construction was formed in 1955 under the sponsorship of the Canadian Construction Association. This Committee represented the Canadian Chamber of Commerce, the Canadian Manufacturers' Association, the National House Builders Association, the Engineering Institute of Canada, the Royal Architectural Institute of Canada, the Canadian and Catholic Confederation of Labour, the Canadian Labour Congress, the Canadian Legion, as well as the sponsoring agency. In addition, representatives of the Federal Department of Labour and the National Research Council were associated with this Committee. The main work of this Committee to date has been to promote winter construction among its own member organizations by giving wide publicity to the advantages of maintaining a high level of employment throughout the year.

The Division of Building Research of the National Research Council has prepared a bulletin outlining techniques for winter construction[1] and a translation of a Swedish document on this same subject.[2] A study has been made of winter construction projects and some specific aspects of construction in winter, notably masonry construction, are being investigated. The study of construction techniques in other countries has been of particular interest particularly in the Scandinavian countries and in the U.S.S.R. where climatic conditions are similar in many respects.

In the translation of the Swedish bulletin on winter construction, the statement appears that state control of the building activity was enacted in order to spread work over the whole year by specifying times at which construction is to start, thus counteracting any unequal burden on the labour market. Details of this system were provided by Mr. Gil Schonning of the Department of Labour on his return from a visit to Scandinavian countries.[3]

In Norway and Sweden two major seasonal industries, construction and farming, dominate summer activity and two, forestry and fishing, are most active in the winter months. Although forestry and fishing always absorbed a sizable portion of the workers released from other seasonally fluctuating industries, statistics show that before the second World War winter unemployment was fairly high in both countries. During the postwar period, industrial expansion tended to outstrip available manpower resources and this led to inflationary pressures that have been reflected in the wage-price spiral of these countries. The high and rising

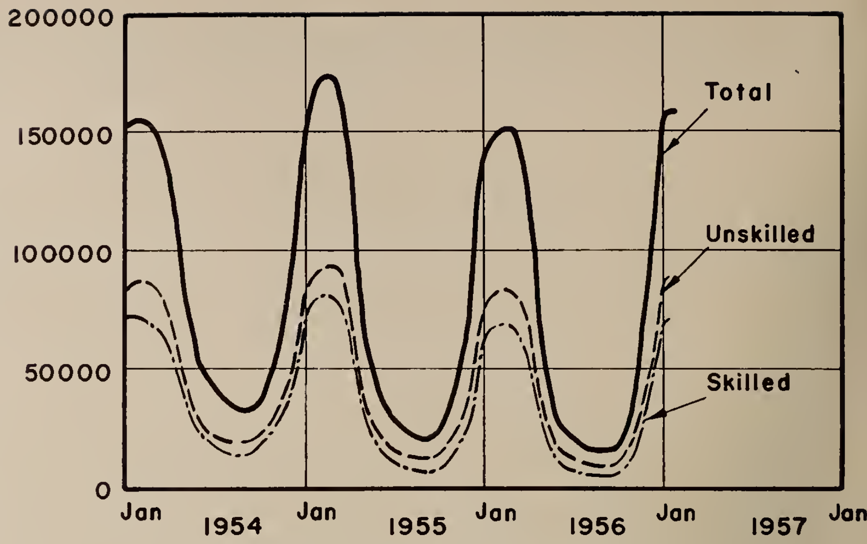


Fig. 1. Unemployment in the construction industry.

level of investment for expansion of industrial capacity and services created a fast-growing construction industry somewhat out of proportion to the size of the countries. The inflationary burst of the construction industry in the summer added force to the already strong pressures on manpower and material generated by the rest of the economy. It was the development of these conditions that prompted Norway and Sweden to bring the construction industry under control.

The main technique introduced by the state with a view to stabilizing employment was the "permit" system. Permits to start work are now a prerequisite to almost all types of construction in Norway and Sweden. The immediate purpose of this scheme was to reduce summer activity and so reduce pressures on the manpower resources; a secondary aim was to stabilize employment in the building industry throughout the year. It was considered that when contractors had sufficient experience with planning year-round work, most of them would accept this new pattern of work as normal, even in the absence of control.

Building permits are issued by government agencies at the state, regional, or local level. Before authorization to begin building is granted, the contractor is required to show a time-table for the building, indicating the duration of work at each stage. If, on examination of the labour markets, the agency finds that sufficient tradesmen are not available for the work, or finds any other justifiable reasons for not allowing construction to proceed, it is empowered to withhold the granting of a permit to begin work. The agency is also authorized to interrupt work if the construction, in the judgment of the agency, should warrant it.

The permit system does not force a contractor to build in the winter, but it may prevent him from building in the summer thus meeting the immediate objective. Both Norway and Sweden have, however, announced national policies respecting year-round activity in construction. Thus a contractor who is granted a permit to build and then lays off large numbers of workers when winter sets in may find that the state agencies are unable to supply him with labour in the following spring and summer.

Apart from the direct approach through the permit system, the governments of the Scandinavian countries assist the construction industry both with respect to long-term capacity growth and to seasonal stability. Systematic planning seems to be the key factor in the attempts to level out construction employment. To assist the contractor in planning year-round work tripartite boards have been established at local, regional, and national levels with representation from the building unions, the contractor, and the state. Although the main function of these boards is to prevent undue pressures on the local labour markets, they also form the main pipeline of communication from research institutions to contractors, and to the public, on new techniques and information about materials.

Research appears to receive strong emphasis in the Scandinavian countries. At present, work is being done by agencies associated with the Ministries of Labour and Housing to determine which construction activities can only be done in summer and which can be done in winter. For example, a study is being conducted in Norway with a view to providing a list of road building and railway maintenance operations that could be done in the winter but that are now being done in the summer.

To utilize more fully the scarce manpower resources, various devices were introduced to stimulate greater labour mobility. The state undertook to cover workers' expenses of moving from place to place and to provide them with accommodation. An educational program was established designed to make the public and the builders aware of the problems and possibilities of winter construction and to disseminate information from research organizations and professional people in the industry. It was found that published information was not widely read by those for whom it was intended and that a more direct approach through short courses and visits to construction sites was more effective.

A study made by the research department of the Swedish Building Trade Unions indicated that it is almost impossible to reduce the summer to winter decline in employment to less than 10 per cent. The problem of additional costs of winter construction has also been studied. It is admitted that a project carried out during the winter months will sometimes cost more, depending on the duration of the project. If it lasted for a year, little or no extra cost might accrue from carrying the project through without interruption. If it was begun in the fall and finished in the spring some extra costs were undoubtedly incurred. It was considered, however, that such matters could not be considered of any significance in comparison with what might happen to wages and prices if the volume of extra work now carried out in the winter were dumped on the already scarce resources available in the summer.

The climate of much of Scandinavia is similar to parts of Canada and it is not strange therefore to find that winter construction techniques are also similar. The requirements for winter concreting are much the same in both countries. Calcium chloride may be used in quantities up to 2 per cent by weight of the cement, forms are insulated to retain the heat in the concrete, and the concrete is heated when the temperature falls below 25°F. The ideal temperature for the concrete during the first three days is considered to be in the range 60°-68°F.

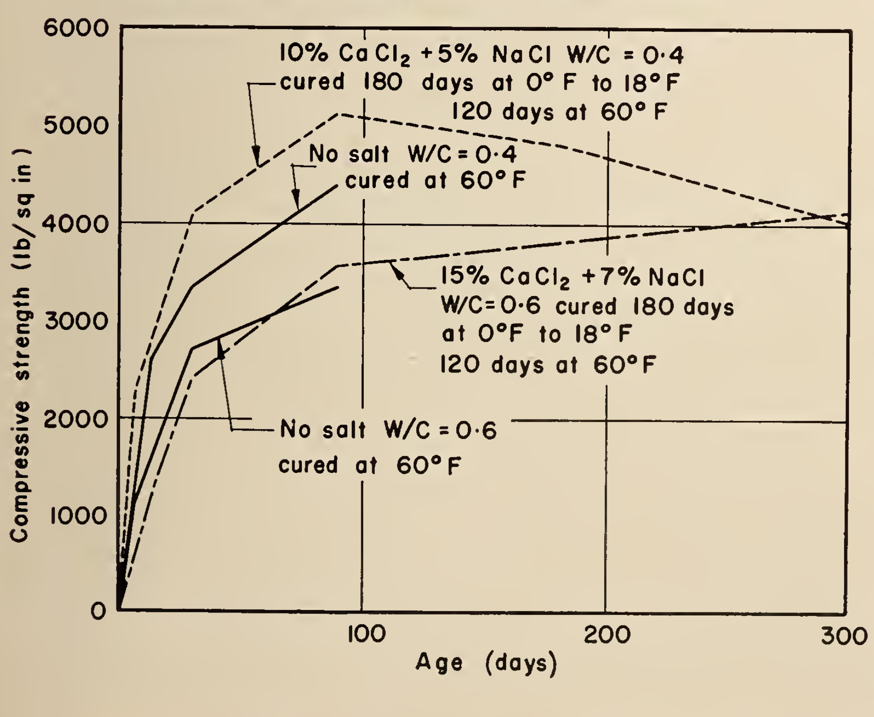
Owing to the fact that parts of Canada are subjected to extreme cold, concreting is done at much lower temperatures here than is normally the case in Scandinavia. For example, in Sweden it is considered possible to place concrete at temperatures down to 5°F., with protection, but contractors in Stockholm do not normally place concrete at this temperature. During the international symposium on winter concreting held in Copenhagen in February 1956, a visit was to be made to construction sites to see ready-mixed concrete being placed. The trip was called off, however, because the weather was too cold, the temperature being about 10°F., although by Canadian standards this is not low.

In the field of masonry construction, the requirements are less rigid than in Canada. Masonry work is allowed to proceed in Sweden and Norway at temperatures down to 14°F., when dry brick and warm mortar are used. In Finland, the minimum temperature for masonry construction is 21°F. and in Denmark 18°F. In all these countries, the work must be covered at the end of each working day to ensure that the walls are protected from rain or snow. Where night temperatures fall below 14°F., the walls are covered with reed mats. In Canada the requirements are that when the temperature falls below 40°F., the materials shall be heated to 40°F., and the masonry kept at 40°F., for 48 hours after being laid up.[4,5,6]

Precast cellular concretes are widely used in the Scandinavian countries where they were developed. These materials are often used as an outside facing for the load-bearing reinforced monolithic concrete used in residential and commercial buildings. By this method the concrete is not directly exposed to the elements. In coastal regions in Sweden and in most of Norway, the high incidence of wind-driven rains makes it necessary to place the insulating cellular concrete on the inside. In most of these areas, however, prefabricated concrete wall panels are used.

Prefabricated concrete wall, floor and roof panels as well as beams and columns are widely used, particularly in the northern parts of Scandinavia. In winter, particularly, this technique assumes great importance since most of the concreting can be carried out under shelter, the joints involving only a small volume of concrete. The joints are made by welding the reinforcement and covering it with concrete. The concrete is protected by small portable insulated

Fig. 2. Compressive strength of "cold concrete" cylinders.



shelters heated in many cases by light bulbs.

Sliding forms are also used on many multi-story buildings. The concrete is insulated by a layer of cellular concrete on the surface. This is considered a good method for winter concreting since the fresh concrete is protected from exposure and the enclosure is easy to heat. It is often used in conjunction with prefabricated floor elements.

Although there is a great deal of work being done in Europe to investigate many aspects of winter construction, the practical application of the work lags far behind these theoretical studies. This is partly due to lack of equipment and an apparent unwillingness on the part of labour to carry on under severe winter conditions. Certainly in Canada winter work goes on in greater relative volume under conditions more severe than those generally experienced in Europe.

No mention has yet been made of winter construction in the U.S.S.R. Practice in that country is of particular interest since the weather conditions in many parts of Russia can be duplicated in Canada. Many new and interesting techniques have been developed in the U.S.S.R. in an attempt to bring the volume and cost of winter construction to the same level as summer construction. Two of the more interesting developments—the use of cold concrete and the curing of concrete—will be described.

"Cold concreting" is the name which has been given to the Russian technique of using large quantities of calcium and sodium chloride in concrete placed in below-freezing weather. Calcium chloride, in quantities up to 2 per cent by weight of cement, has been widely used for years as an accelerator to increase the early strength of concrete placed in cold weather. In such cases, the anti-freeze property of the salt solution is ignored since the freezing point is lowered by only a few degrees. In the U.S.S.R., however, the chloride salts are used as an anti-freeze.

The amount of salt used is high, the maximum recommended being 20 per cent salt by weight of the water for use where minimum temperatures do not exceed —5°F. The ratio of calcium chloride to sodium chloride in the admixture depends on the air temperatures during curing and the time that the concrete can be left in the forms. But equal parts of NaCl and $CaCl_2$ are used where air temperatures are between +5°F. and —5°F.

The compressive strength of concrete made with large additions of chloride salts is high, and at temperatures between 0°F. and 18°F., design strengths are obtained in about 90 days. Where $CaCl_2$ alone or a mixture of salts high in $CaCl_2$ is used, quick setting and high early strength result. Later the rate of development of compressive strength slows down and in some cases an actual loss of strength occurs. When NaCl alone is used, the development of strength is slow at an early age, but at 270 to 300 days, the compressive strength exceeds that of the concrete with $CaCl_2$. Temperature has a marked effect on strength development, and if the air temperature is above freezing, very high strengths are recorded after only a few days.

The impermeability of cold concrete is higher than ordinary concrete, but its durability, as measured by resistance to freeze-thaw cycling, is low. Rapid corrosion of reinforcement occurs unless the concrete is dense and provides a cover of more than 1 inch. Well-graded high-quality aggregates are essential for reinforced concrete and the water-cement ratio should not exceed 0.5. Even then reinforced concrete should not be exposed to humidities in excess of 60 per cent.

Since 1952, when cold concrete was first used, until January 1956, 200,000 cubic yards had been placed in the U.S.S.R. It is used for retaining walls, canal structures, secondary roads, and building and machinery foundations. Concrete with large salt additions is not recommended, however, for the following conditions:

(*a*) reinforced concrete in areas where relative humidity exceeds 60 per cent;

(*b*) reinforced concrete subjected to alternate wetting and drying cycles;

(*c*) reinforced concrete where thorough compaction is difficult;

(*d*) reinforced concrete where cover is less than 1 inch;

(*e*) prestressed concrete;

(*f*) structures where good appearance is an essential requirement; and

(*g*) in massive structures with low surface area.

The properties of cold concrete as given above are all based on Russian reports.[7] There appears to be little information from other countries on concrete containing a high percentage of salts although at the recent annual meeting in Dallas of the American Concrete Institute it was reported that an American investigation had confirmed the low resistance of such concrete to freeze-thaw cycling.

Fig. 3. Winter construction in Edmonton.
Photograph: Goertz Studios

In the U.S.S.R., as in Canada, there has been great activity in hydro-electric power development. Since much of the concrete for the hydraulic structures must be placed during the winter months, a system has been developed for heating the surfaces of the concrete by electricity. Electrodes of ¼ inch to ⅜ inch round steel are placed at intervals of 8 to 12 inches on the inside of the forms and on adjacent concrete surfaces. The electrodes are heated by low voltage (50 to 90 volts) alternating current. The approximate time for electric heating is set as follows: for an air temperature of 15°F., 8 hours; for —5°F., 16 to 24 hours; for —20°F., 32 to 40 hours. Electricity is supplied by portable 50-kilowatt three-phase oil transformers and the consumption at —20°F., is 6 kilowatts per square yard of exposed surface.

The advantage of this system is that it permits the placing of concrete with a temperature of 40°F., without the danger of freezing at the edges and it does not require a heated structure around the concrete during the curing period. The top surfaces of the concrete blocks are not electrically heated but are covered and insulated. Unheated shelters are erected over the blocks only during prolonged periods at temperatures below 0°F.

In spite of the development of new materials and techniques of winter concreting, prefabrication is still widely used by Russian contractors. Residential, commercial, and many industrial buildings, are constructed the year round of prefabricated floor, wall, and roof panels, beams and columns. Most of these components are made of factory produced concrete which in winter can be placed and cured under optimum temperature conditions. The parts are erected by large cranes and the connections between components are made by welding the reinforcement and grouting the joints. High early strength concrete is often used and where necessary small portable heated shelters are used.

Although concrete is the chief material used in prefabricated components for buildings, brick masonry is also prefabricated into wall panels and columns, and lifted into place after curing by means of mobile cranes. In winter, the brick masonry is generally prepared in heated enclosures or protected by electrical heating. In some cases, however, the masonry is allowed to freeze as quickly as possible and the blocks develop sufficient strength by freezing to permit transporting them to the construction site and lifting them into position. Blocks prepared at freezing temperatures become fit for transportation within a few hours if the temperature is very low or within 10 to 15 hours at temperatures just below the freezing point. The blocks are placed on a thin layer of warm mortar which may have "anti-freeze" agents incorporated in the mix. These chemical admixtures are always used when it is known that the temperature will fluctuate around the freezing point or when a sudden thaw can be expected. Walls erected with frozen masonry blocks lose considerable strength when they thaw and some settlement occurs, often as much as 0.015 foot per foot in height. As the mortar hardens at temperatures above freezing, the walls gradually acquire the necessary strength and stability.

The details given above should not leave the impression that the Russians have developed new techniques which permit full-scale winter construction without the protection required in Canada. The quantity of "cold concrete" used to date is very small in terms of any large construction job. Electric heating of concrete is chiefly confined to some hydro-electric projects and the technique of freezing masonry blocks is still under study. Although the records show that much experimental work is in progress to improve these methods, they do indicate that something more can be done about cold weather construction. At the same time, it must be kept in mind that the laws of nature have not been repealed, and it is still as necessary as ever to recognize the hazards of winter construction.

Turning now to winter construction in Canada, there seems to be little doubt that this country leads the world in *per capita* volume of winter work. A study of practices in other parts of the world show that, with the possible exception of the U.S.S.R. and the United States, no country normally carries on winter construction under such severe weather as is experienced in the Prairies in winter. This is partly due to the climate of other countries since the U.S.S.R. and North-western United States are the only areas where similar climatic conditions to those of Canada exist. Even in Canada, however, there are great variations in winter construction activity depending on local conditions. During the winter 1956/57, for example, a great deal of winter construction work was carried out in the Prairie Provinces. Contractors and engineers in this part of Canada face the most severe winter conditions in the country, although it must be admitted that in the Far North the severe weather lasts for a longer period. Western builders, while naturally proud of their ability to cope with the existing conditions, look with envy on contractors in other parts of Canada where weather conditions make winter construction more attractive. They are naturally surprised to find that most construction jobs in Vancouver were shut down for six weeks because of the severe local weather—snow on the ground and temperatures down to +10°F., to +20°F. This would almost indicate that local custom often decides what can be done in winter in any given area.

Fig. 4. Laminated wood arch enclosure.
Photograph: Brian Akins, "Techniques of Winter Construction"

Canadian contractors have developed some ingenious methods of combating winter weather. Many types of hoarding are used including movable enclosed platforms suspended from outriggers on the roof of the building and laminated arch structures made from 1 x 4 lumber, reinforced kraft paper and polythene film. This latter type of enclosure was very successfully used with the lift-slab type of construction at the Winnipeg General Hospital.

The use of the lift-slab method of construction seems to be well suited to winter work. The floor and roof slabs, since they are all placed at ground level, can be protected by low cost structures which require little headroom and are easy to heat. When the slabs are cured they can be hoisted into place in temperatures as low as —20°F. Once the slabs are in place, the sides of the structure can be enclosed with canvas or polythene permitting work to continue without interruption.

Prefabricated wall, floor and roof panels are being specified on an increasing number of construction jobs in Canada, but in spite of the obvious advantages for winter work, the potential of this method of construction has not been fully exploited. Since these panels can be fabricated under controlled conditions, the weather at the site would have little effect on building progress. The use of prefabricated wall panels, in conjunction with the lift-slab method of construction, would seem to remove most of the difficulties of winter construction in many types of buildings.

It would be well to look briefly at some specific winter jobs in the various categories of construction to see what can be done. These may not be typical examples but they do show that "where there's a will, there's a way".

Ottawa house builder, Heinz Kroeger, found a circus tent the answer to his winter construction problem. The excavation was made in early February and the tent erected over the excavation. Four blower-type heaters maintained a temperature of 38° to 40°F., under the tent even when the outside temperature dropped to —20°F. Meanwhile, the foundation walls were placed, the frame erected, roof installed, brick veneer, stucco and plaster applied and even some outside painting was completed. Four weeks from the time the excavation was started, the tent was stripped and moved to a second house. The total extra cost was estimated by the builder at $300 to $500 but the advantages of continued work the year round were considered to be worth a great deal more.

In Winnipeg, the contract for a new bank building was awarded on 1 December 1955. The date of occupancy was set by the bank officials to be 15 March 1956. Thus, it was necessary to construct this building in its entirety during a period when very severe weather conditions are normal. By careful planning, the building was completed at an estimated additional cost of hoarding and heating of $500, or 1¼ per cent of the completed building cost.

In Hull, Quebec, two almost identical school buildings were erected by the same contractor, Mr. Raymond Brunet, one in summer and one in winter. The additional cost of the winter job was $4,800 or ¾ of 1 per cent of the total building cost. In addition, by starting in the late fall, the school was finished four months ahead of the original schedule.

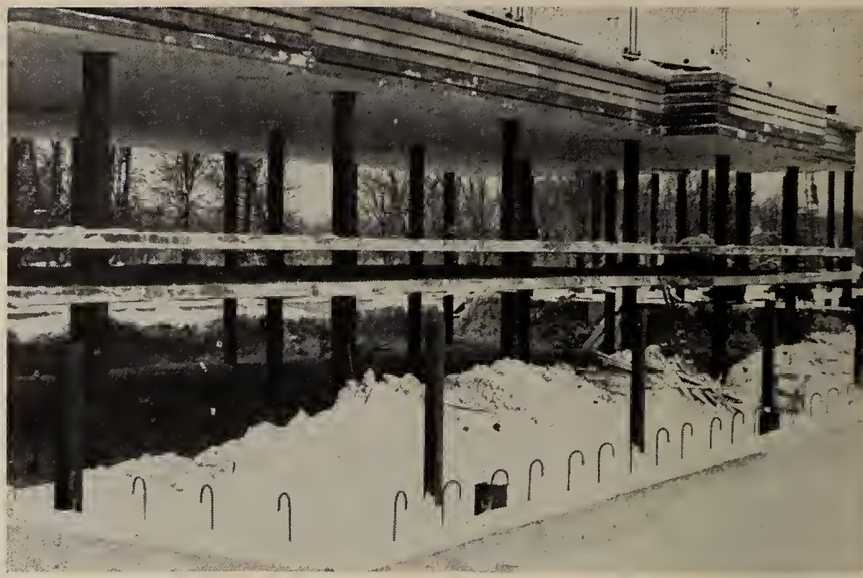


Fig. 5. Winter erection of a lift slab apartment block.
Photograph: Brian Akins, "Techniques of Winter Construction"

Many more examples could be given to show that all phases of construction, even excavation and outside painting, can be done in winter. There is always, however, an additional direct cost of winter construction since it is just not possible to enclose and heat a structure without incurring some expense. In addition, ready mix concrete costs more in winter and this can be a substantial item in some types of buildings. There are, however, many immediate compensations such as retention of skilled labour, good materials delivery, availability of subtrades, reduction in overhead, and early completion. Another factor that is not generally considered is the reduced labour costs of winter construction. Since 1934 there has been a steady increase in wages in the construction industry which, since the end of the second World War, has amounted to just under 8 per cent per year on the average. Material costs have also risen, although not to the same extent. That this factor may compensate for the added cost of winter construction is seen in cases where alternate tenders are called in the fall, one for an immediate start and the other for a spring start. In many such cases, the bids are the same.

Since it has been shown that winter construction is possible in Canada, and at an acceptable cost, what can be done to reduce unemployment in the construction industry during the winter months? The answer seems to be in convincing the owner that the quality of winter work is as high as summer work and that the additional direct cost is offset by many factors of which early occupancy and lower labour costs are but two. The Engineering Institute of Canada and the Royal Architectural Institute of Canada can do a great deal to promote winter construction, but only when the members of the two professional bodies are themselves convinced that it can be done and done properly. Whether this is the case can only be judged by the statements issued at the request of the Joint Committee on Wintertime Construction.

The E.I.C. stated: "Engineering projects are not shut down in winter when the cost of shutdown, including the interest on funds invested, exceeds the extra cost involved in winter construction.

"While there are exceptions, the quality of construction work carried out in winter in Canada need not suffer provided planning, supervision, and control of work is done by qualified engineers."

The statement of the R.A.I.C. read in part:

"It is felt that generally speaking wintertime construction is feasible provided that proper precautions are taken. It is recommended that before any decisions are made the proposals should be discussed with the architects of the buildings in the light of all circumstances such as climate, type of construction, site conditions, materials, costs, etc."

Contrast this with a statement made in the findings of a committee established by President Hoover in 1921 to study and report on seasonal operation in construction. It states: "Summarizing the question of winter construction it may be stated without fear of contradiction that both from an engineering and quality standpoint any type of modern building construction can be accomplished, and most classes of engineering construction fully as well, in the winter months as at other seasons, if the proper protection during the progress of certain parts of the work is provided."

In the meantime, much valuable work is being done by local committees across the country, particularly in regard to the timing of maintenance work. This effort has been very successful and may well establish a permanent pattern. In addition, the trade journals are giving much publicity to winter construction programs and the techniques developed by individual builders to meet the challenge of local conditions.

The Division of Building Research, besides issuing several bulletins on winter construction, is making studies of specific problems such as the use of masonry construction in winter. This study was started as the result of a request from a builder who pointed out the difficulties of complying with the existing regulations regarding the protection of masonry during cold weather. Investigation has shown that the existing regulations are based on the results of work done between 1923 and 1935, to determine the effect of low temperatures on concrete. The need for laboratory work to determine the effect of low temperatures not on concrete or on mortar, but on the combination of mortar and brick, is clearly indicated. This presents such a complex problem, however, that only after years of work will the answer be found.

In the meantime, where the regulations do not apply or where inspection is lax, brick masonry is being erected in winter under extremely adverse conditions with no apparent ill effects. There does seem to be some hope for the relaxation of existing requirements at least for non-load-bearing walls, but if such a change is to come soon it will probably be based on current practice in this and other countries rather than on laboratory investigations. In Europe, masonry construction is permitted at lower temperatures than in Canada and it may be possible to use the experience gained in these countries to adopt a more realistic approach to this problem.

Winter construction in Canada is now a well established practice and each year more and more people enjoy year-round employment in this great Canadian industry. There are still, however, great numbers of skilled and unskilled construction workers seeking employment during winter months. It is to the advantage of all Canadians to make every effort to ensure that seasonal unemployment is kept to a minimum. In the construction industry this should mean keeping the summer to winter decline to 10 per cent. That this can be done is shown by the fact that during the past five years 45 per cent of all construction work carried out by Defence Construction Limited was put in place each year in the six months between November and April.

One out of every five dollars spent in Canada today on end goods and services is spent on construction. This country cannot afford to shut down or even to slow down appreciably so vital an industry as construction. The so-called "construction season" is a term that should soon be out-dated. Canada must build the year round.

Fig. 6. Masonry construction in Winnipeg
Photograph: Gordon Aikman, Public Works in Canada

Acknowledgement

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References

1. Crocker, C. R. and D. C. Tibbetts. Winter Construction. National Research Council, Division of Building Research, Better Building Bulletin No. 6.
2. Näslund, Bertil. Winter Construction. National Research Council, Technical Translation No. TT-583.
3. Schonning, G. Seasonal Employment Fluctuations and the Building Industry in Scandinavia. Labour Gazette, 56:1370-4, November 1956.
4. National Research Council of Canada, Associate Committee on National Building Code, National Building Code of Canada, 1953. Section 4.4 Unit Masonry, p. 11, para. 4.4.6.3. (b).
5. Central Mortgage and Housing Corporation. Building Standards, 1955, p. 47, Section 21 (b) 10.
6. Technical Notes on Brick and Tile Construction, Vol. 7, No. 1, January 1956. Cold Weather Masonry Consruction, Structural Clay Products Institute, Washington.
7. Mironov, S. A. and B. A. Krylov. Concrete with Chloride Salts in Winter Conditions. RILEM Symposium on Winter Concreting, Proceedings Session D. Discussion, p. 55-93. Copenhagen, February 1956.

Installation and Operating Experiences with Kemano 2500 Foot Head Impulse Turbines

J. T. Madill, M.E.I.C.
Manager, Power Operations, B.C.
Aluminum Company of Canada Limited, Kitimat, B.C.

F. P. Gordon, Jr.E.I.C.
Master Mechanic, Aluminum Company of Canada, Limited, Kemano, B.C.

Read at a meeting of the Vancouver Branch of the Engineering Institute of Canada, 24th October, 1956

The Kitimat, B.C., smelter of the Aluminum Company of Canada is supplied with electrical power from the powerhouse at Kemano, B.C. This paper describes the installation of the first three vertical impulse turbines in the Kemano station, and gives some details of operating experience and test results.

THIS PAPER describes the installation of the initial three 150,000 h.p. 4-nozzle vertical impulse turbines in the Kemano power station of the Aluminum Company of Canada, Ltd., and includes some operating experience and test results.

The turbines are 4-jet vertical impulse machines operating under a net head of 2,500 ft. and producing 150,000 h.p. at 327 r.p.m. The manifold inlet diameter is 60 inches; the jet diameter approximately 8½ inches. Runner pitch circles vary from 132 in. to 134⅝ in. The turbines were manufactured by Canadian Allis Chalmers, Ltd., Vancouver Iron Works Ltd., and Dominion Engineering Co. Ltd.

The water supply for the Kemano power station is obtained from a chain of lakes forming a reservoir in Tweedsmuir Park on the east side of the Coast Range. From an elevation of 2,800 ft. at Tahtsa Lake the water passes through a 10 mile tunnel to a point about 2,600 ft. above the powerhouse then drops through eleven-foot diameter penstocks to discharge at elevation 210 feet before release into the Kemano River.

Turbine installation starts with the bottom pour of concrete, including support pedestals for pit liner bottom (Fig. 1). In addition to the visible pads anchor, eyes were also set in the concrete to provide a solid tie-down for the bottom plate. The bottom plate (Fig. 2) made up of five sections of ½ in. plate, was reinforced with 8 in. wide flange I-beams which were spaced approximately on 3-1/3 ft. centres running parallel to the longitudinal centreline of the powerhouse, and which rested on jacks on the support rods. Turnbuckles fastened between pad eyes on these beams and the anchor eyes provided the necessary anchorage; 1¼ in. pipe jacks were added, wherever required, to make local adjustments. Further anchorage and adjustment was obtained by use of turnbuckles and pipe jacks between the plate edge and the pit walls. Once in place the sections were welded, followed by a further adjustment check and correction where required. Fig. 2 shows the bottom plate in position at elevation 184 with the first course in place. One-inch turnbuckles and tie rods can be seen attached between liner and pit wall. The centre shoring ring originally provided as a steel set for tunnel work was supported on 4 in. x 6 in. posts and braced

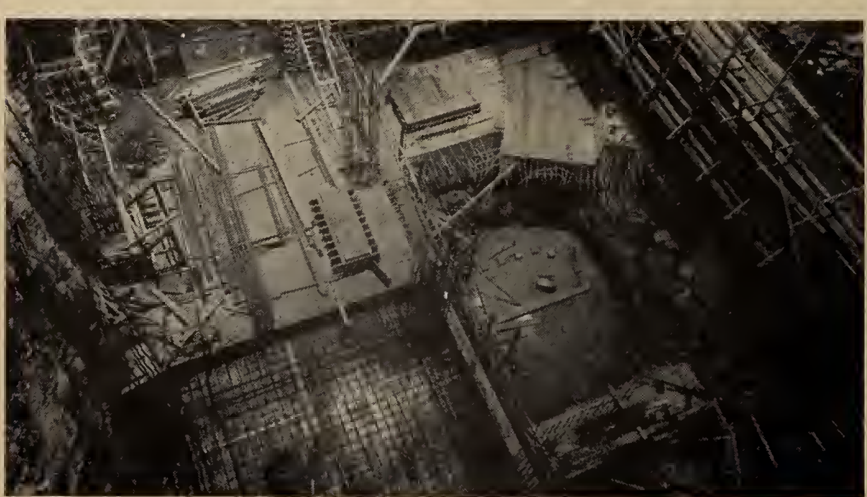


Fig. 1. Lower concrete showing support pedestals for pit liner bottom.

against the liner wall. A 4 in. pipe was welded across the 16 foot discharge opening to hold it to the correct width. This pit liner is 26 ft. 3 in. in diameter.

The second course, in two sections identical to the first, was butted to the first course and braced in place. The third course was added in a similar manner (Fig. 3) but, since it formed the cover for the discharge opening, it was the first completely circular course.

Runner removal platform beams were added when the course was in place (Fig. 4). These are two 18 in. W.F.I.-beams, which protrude through the liner and which are stiffened by two short beams at either end, braced against the liner wall. Grating was later added in front of the door and along the outside of each main beam to provide a walkway to facilitate inspection. With this course in place and all necessary drain lines installed, preparations began for prepakting to the 205 elevation.

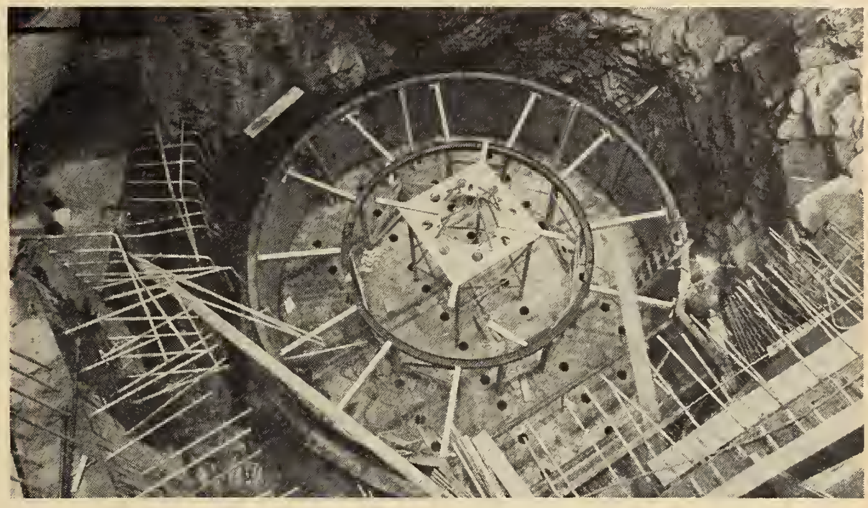
Prepakting differs from conventional concrete roughly in that aggregate is placed in the void first and a grouting mixture pumped into it through piping suitably located before the aggregate was added. There was no floating or lifting action noticed on the bottom section and no distortion in the liner walls. Some hollow spots were found but were mainly very shallow. As the grout is pumped into place it rises in "cones" about the pipes and drives ahead of it a considerable amount of water which must be removed. When the surface starts to flood, the area between the pipes is probed and grout pumped in until the space between the cones has been filled.

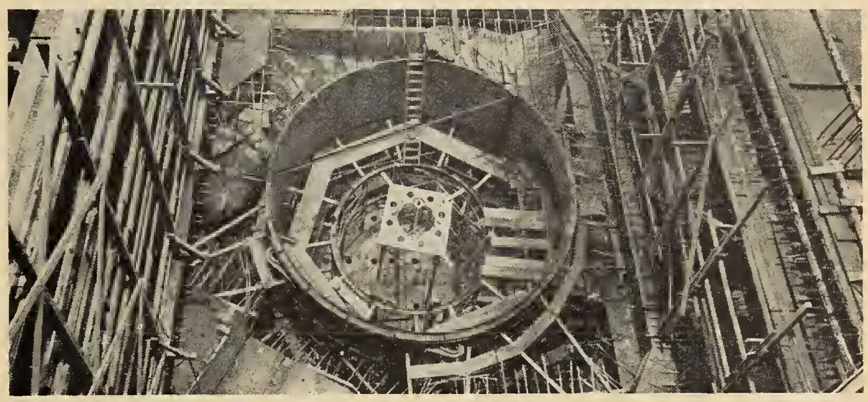
Basically, the erecting procedure for all unit pit liners was the same as the above.

The shapes varied considerably; two are more or less circular, while one could be classed as octagonal. The circular shaped liners were easiest to erect and align. Welding of the joints was a considerable job on all three. It was felt that the welding could be reduced considerably since, in many cases, seal passes could replace a full weld.

The handling problem was affected by the weight and shape of the course sections. In unit 2 they were small and light, being made of ⅜ in. plate averaging 6 feet in height and 8 feet in length. These sections were easily handled by a jury rig, permitting assembly to a greater height before shoring was added and alignment corrected. In unit 3 the sections were very heavy, being made of 1 in. plate with 10 in. channel stiffeners. Because of the size and weight of the sections considerable effort was expended, manoeuvring them into position. However, this provides a very substantial pit line, which, from an operating point of view, is a real advantage.

Scroll case sections (Fig. 5) were





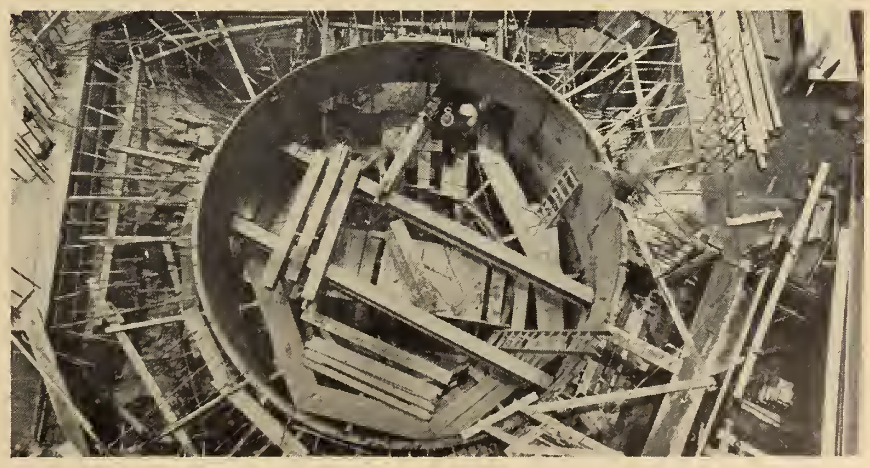


Fig. 2. Bottom plate and lowest pit wall plates.

Fig. 3. Third ring of pit liner plates.

Fig. 4. Runner removal beams in place.

Fig. 5. Scroll case section.

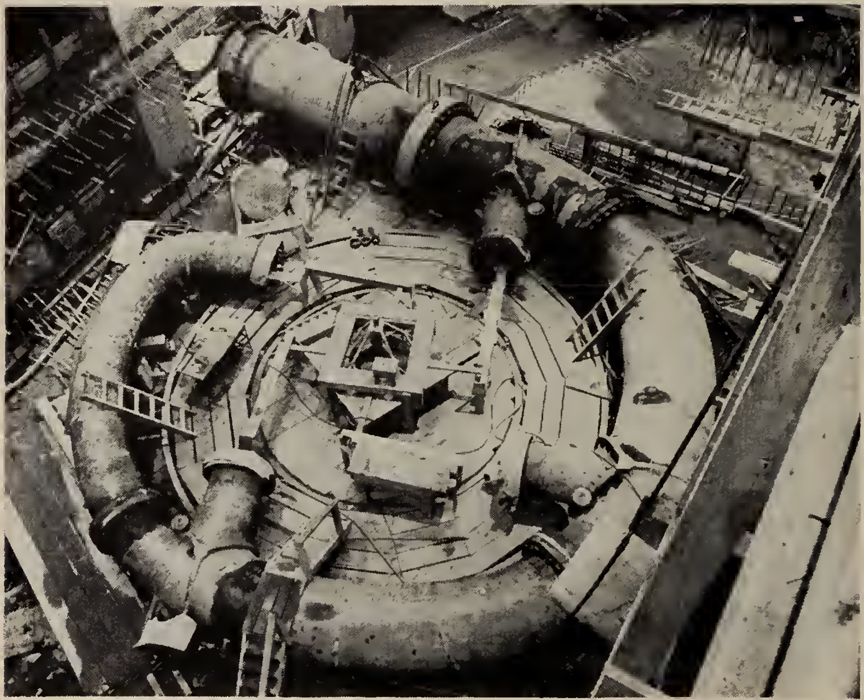


Fig. 6. Scroll case bolted together.

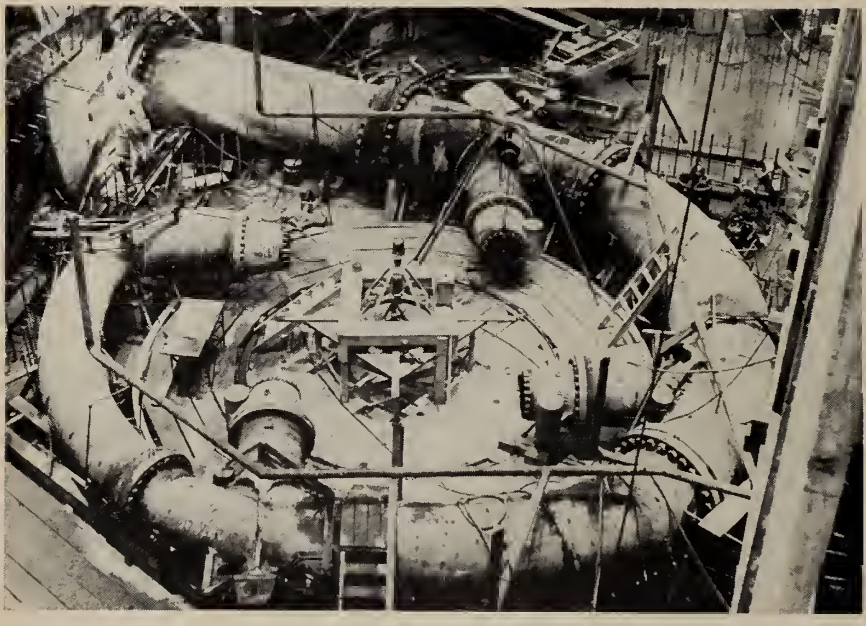


Fig. 7. Test heads installed.

brought in on a heavy trailer unit through the tailrace and up unit 4 discharge which had been filled in and graded to provide a roadway to the 205 elevation. The tailrace was used as a main supply tunnel all through the final excavation and construction.

In unit 2 there were five flanged sections including the inlet section. The heaviest piece weighed about 34 tons. Except for the inlet section connection to No. 1 nozzle body all joints were bolted and dowelled with a "dutchman" or spacer plate between, which had been grooved to take a ¼ in. diameter neoprene gasket.

The inlet section bolted directly to No. 1 nozzle body without dowelling; the flange was grooved for a ¼ in. gasket.

With the sections roughly aligned, bolting proceeded (Fig. 6) until all joints were secure and the bolts stretched approximately 0.001 in./in. of grip. Repeat checks were made on nozzle alignment to keep them within reasonable limits during the operation. Tie downs were attached plus extra turnbuckles to permit lengthwise adjustment of the sections. Nozzle alignment was obtained as follows.

From the arms of the centring stand, supported on the runner removal platform, piano wire, 0.016 in. dia., was strung through the centre of each nozzle to a centring plate located snugly in the bore of each needle gland at the servomotor end of the nozzle where it was securely fastened. The opposite end ran over a grooved pulley on the arm and was held taut with a 30 lb. weight. The pulley was adjusted for height and distance from centre so that the wire at the pulley lay on the tangent point between nozzle centre line and runner pitch circle. The casing was then manoeuvred until each servo centre plate centre was on elevation and the wire was central in each nozzle. During this process the upstream flange of the inlet section was kept in its proper location. The result put the nozzle centre lines within the tolerance required by the manufacturer of $\pm 1/8$ in. horizontally and $\pm 1/16$ in. vertically.

On completion of the alignment, test heads were attached (Fig. 7) as well as all piping which would be subjected to full penstock pressure. A pressure test was made by means of a hand pump at 1850 p.s.i. for two hours. To check movement of the scroll case during the test, dial indicators were set up at the test head behind No. 2 nozzle and at No. 4 nozzle. Though the casing did move under pressure, an alignment check made afterwards showed that it returned to its previous position. The specification that all joints be drop tight was adhered to and attained in all cases.

After alignment was completed, the remainder of the pit liner, plus baffle plates and air vent piping, was installed and the pit cover set in place. This cover (Fig. 8) came in sections consisting of an inner ring or wheel pit cover, which bolted to an outer or foundation ring, to which I-beam channels were welded, which in turn carried the segmental cover plates welded to the bottom of the beams. These parts were assembled beforehand and the assembly installed as a unit on the top course of the liner (Fig. 9). Final alignment and attachment of this cover came after all welding was completed on the liner and the prepakt elevation was raised to cover the scroll case and secure the cover adjusting anchors at elevation 214.

Unit 1 scroll case installation was the same as for unit 2. There were ten flanged and bolted sections including the inlet section; no dutchmen were used. The flanges were grooved to take a ⅜ in. dia. rubber gasket as a seal. Bolting procedures varied a little in that the stretch of 0.001 in./inch of grip was applied in two stages. The second stretch was applied after the pressure test as a check to ensure that all bolts were secure.

With the cover in place on unit 2 the rockshaft bearing supports were installed and mandrels were fitted to replace the rockshafts which had been delayed. Preparations were then made for concreting to the 218 elevation (Fig. 10). Meanwhile, needle stems, needles, nozzle tips, and needle servomotor installation had begun.

The assembly of the pit liners continued after the tests and the pit cover was placed. The next stage of prepakting brought the level to 214 elevation. The final setting of the cover was then completed, pipe supports were placed under it to prevent any sag during concreting and the level raised to the 217 elevation (Fig. 11, unit 1).

The wheel pit cover was dowelled in place and the bearing support fitted. The remaining work consisted of

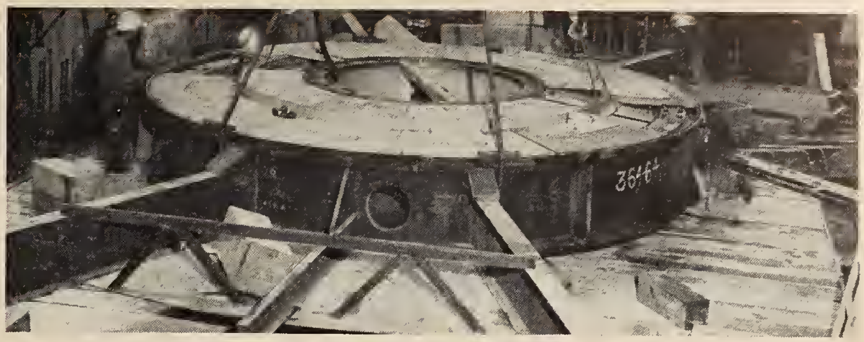


Fig. 8. Pit cover.

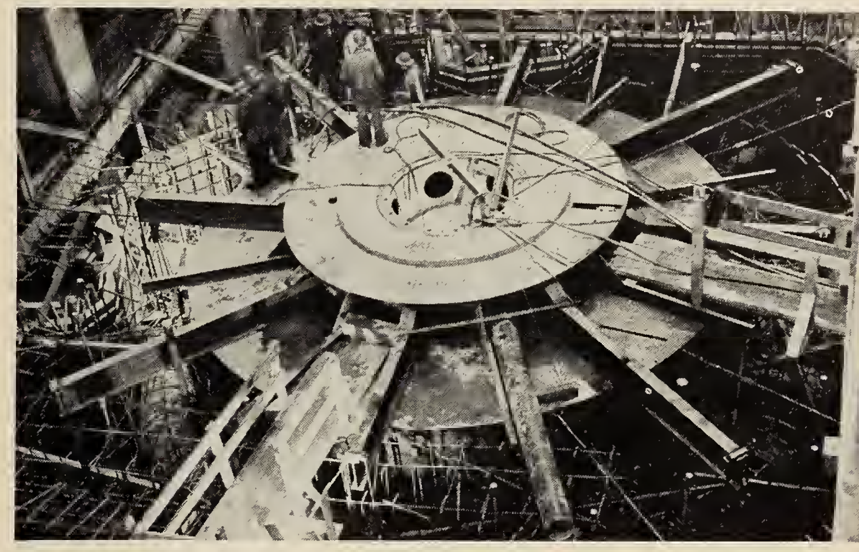


Fig. 9. Pit cover in place.

Fig. 10. Pit cover ready for concrete encasement — unit 2.

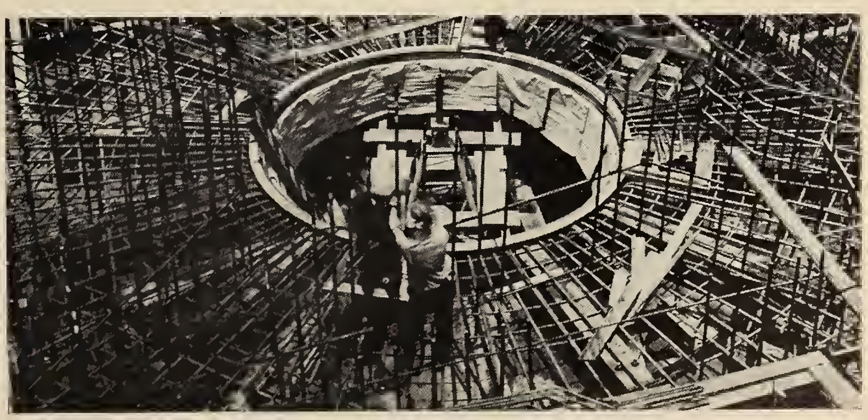


Fig. 11. Unit 1 ready for concrete encasement.

Fig. 12. Needle guide barrel.

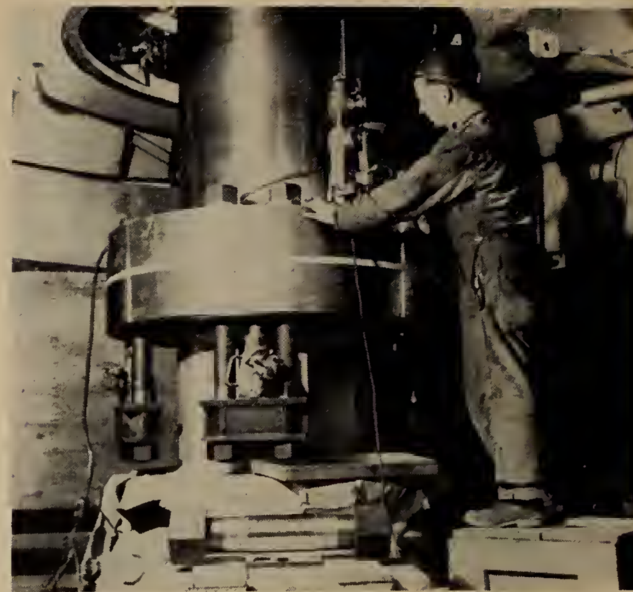


Fig. 13. Final boring coupling bolt holes.

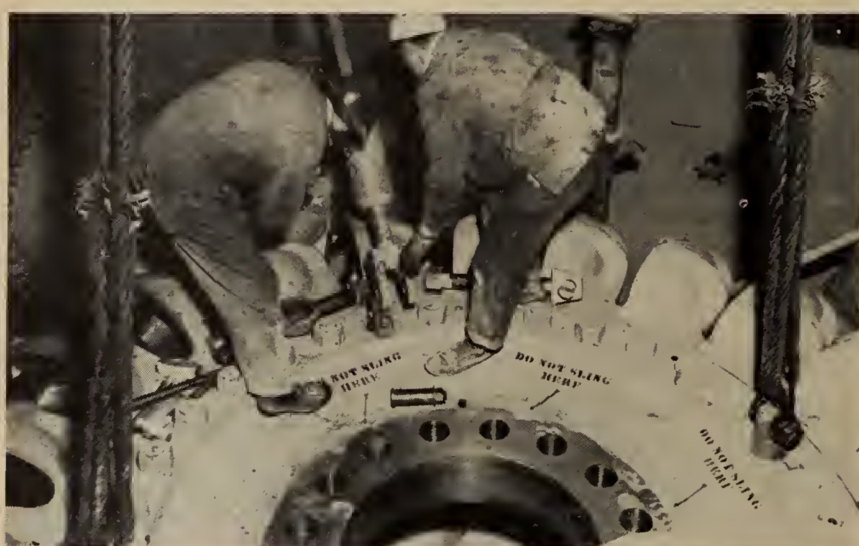


Fig. 14. Turbine No. 3 runner.

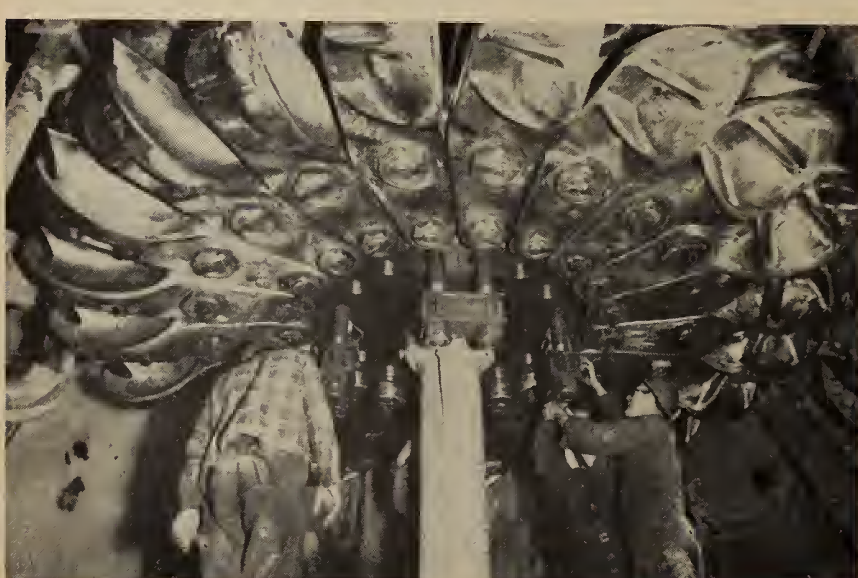


Fig. 15. Turbine No. 2 runner lifted into position.

completing the nozzle assemblies, installing the rockshafts, deflectors, linkage and servomotor, as well as setting the governors, pressure tanks and restoring cable piping. Briefly, the needle assembly consists of needle, servomotor, needle stem, needle tip and back, which are connected together to form a unit. The nozzle tip containing the needle seat is bolted to the nozzle body and provides a vertical bearing housing to guide the lower end of the rockshaft to which the deflector is keyed. Support for the needle stems, which vary in length from 12-18 feet, is obtained by guide bushings located in the nozzle body and at the servomotor end. Fig. 12 shows a needle guide barrel being installed in unit 1.

The turbine shafts were lowered into position. No. 1 turbine shaft was lowered on to a plate disc supported by four 2½ in. bolts from the pit cover and was then levelled and centred so that the generator erection could proceed. No. 2 turbine shaft was supported in its bearing and was coupled up with temporary bolts to the rotor which was installed immediately after. Reaming of the coupling bolt holes proceeded immediately (Fig. 13).

The next major items to be installed were the runners for all three units and the turbine shaft for unit 3. Unit 3 runner (Fig. 14) was made up of an integrally cast 13 per cent chrome bucket ring having 23 buckets and supported by a two-piece disc which clamped to it; the weight was approximately 22 tons. It was installed from the top and supported on special turn buckles attached to the pit cover. The inner cover was then lowered into position, the turbine shaft placed on the runner and bolted up, and the shaft and runner assembly weight then transferred to a support stand on the cover.

Unit 2 runner (Fig. 15) was a cast steel bolted-bucket type having 22 buckets; it weighed approximately 30 tons. Unit 1 runner was a forged plate steel integrally welded 24-bucket wheel which weighed approximately 24 tons (Fig. 16). These two runners were installed from below by means of a special car and hydraulic jacking unit. Figs. 15, 16, 17, and 18, though they show two different runners, depict the method of installation. The lift from car to shaft coupling takes approximately 10 min. at 1800 p.s.i.

Turbine erection at this point was complete except for governor checks.

Operation

From an operating point of view, the turbines behaved most satisfactorily in all but one respect, and all delivered more than 150,000 h.p. To determine accurately the turbine discharge and efficiency, Gibson tests were conducted on all three by the firm of Norman R. Gibson, consulting engineers, of Niagara Falls, N.Y. The piezometer sections for these tests had been included in the design and installed in consultation with Dr. Gibson's firm. Table I and Fig. 21 give the essential data from this test work and these are the final and official figures. It will be seen that all units show a high efficiency over the range 90,000 to 150,000 h.p. and all produce in excess of 150,000 h.p. Since all units were tested by the same engineers, using the same equipment and instruments and identical test sections, it is considered that these results, relatively, are highly accurate. Incidentally, deceleration tests had been conducted previously on each generator, so the turbine output was accurately determined in all cases.

In the case of two turbine runners, cavitation of the back of the tip of the bucket splitters occurred. The condition in Fig. 19 was found after only a couple of weeks' operation, and that in Fig. 20 after about a month. This problem was attacked in both cases from two points of view: first, change and improvement in bucket contour in the critical area, to eliminate as far as possible the cavitation; and second, metallurgically to improve the material.

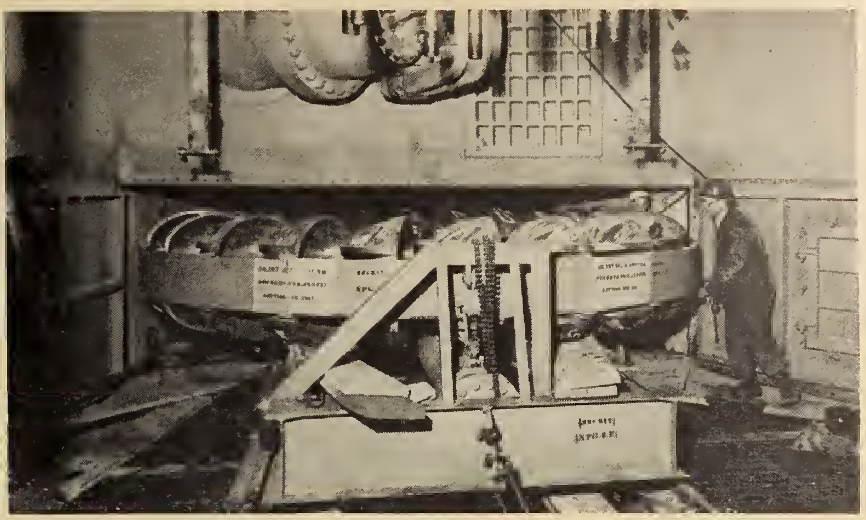


Fig. 16. Turbine No. 2 runner on removal car.

Fig. 17. Runner lifting guide rod in place.

Fig. 18. Runner lifting piston part way up.

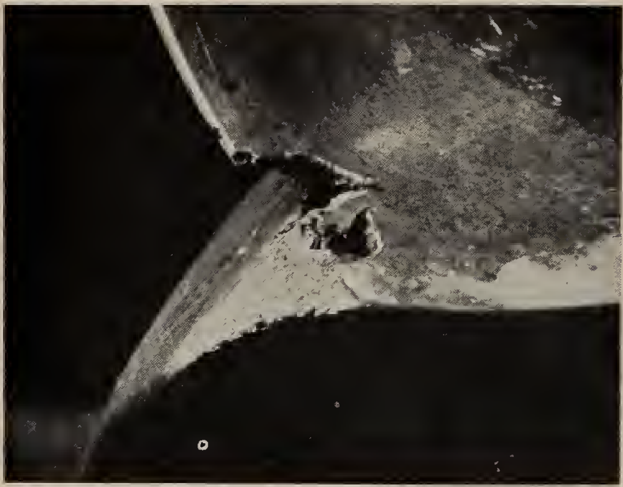


Fig. 19. Splitter tip cavitation.

Fig. 20. Splitter tip cavitation.

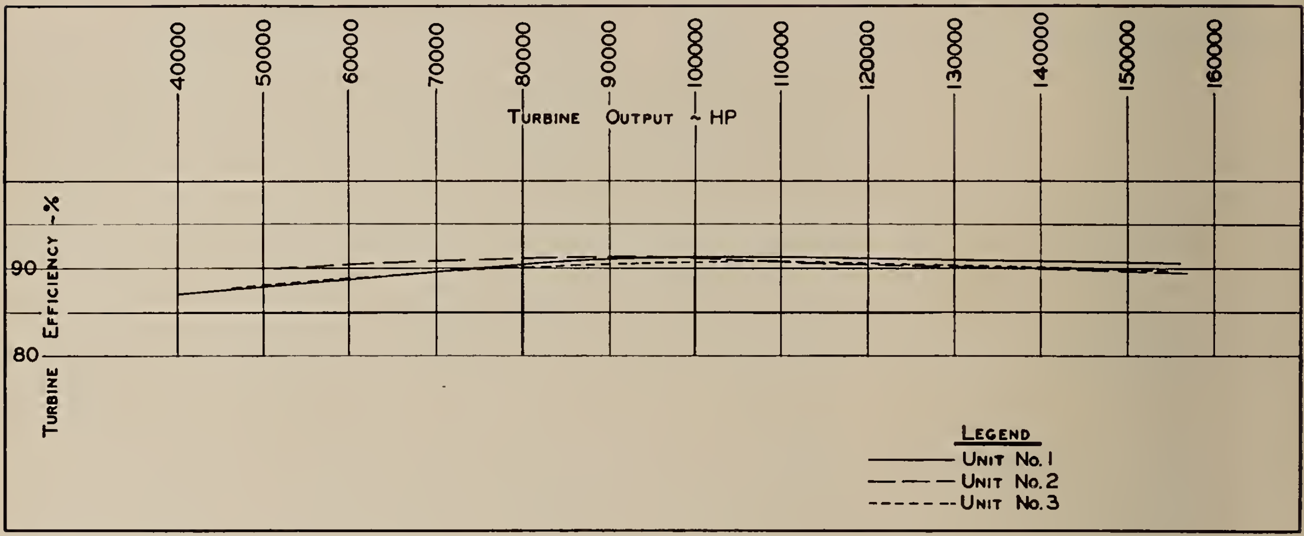


Fig. 21. Kemano turbines efficiency curves.

Table I. — Kemano Turbines Gibson Test Results

Unit No.	*Av. Eff. % 90,000–150,000 h.p.*	*Max. Eff. %*	*Max. Output h.p.*	*Max. Discharge c.f.s.*
1	91.0	91.4	156,000	607.5
2	90.6	91.4	157,700	620.7
3	90.5	90.9	154,300	607.0

The metallurgical story is an interesting one. The objective was to produce an 18-8 alloy tip on all buckets. This was attempted by straight build-up, and by welding on 18-8 prefabricated tips. In either case a layer of 25-20 alloy was laid down on the carbon steel of the bucket. Serious cracks developed and almost simultaneously both manufacturers, and Alcan through the Ontario Research Foundation, concluded that the 25-20 was causing the trouble as it is liable to hot-cracking, especially when deposited on carbon steel. A charge to 29-9 removed this difficulty and permitted the sound attachment or build-up of 18-8 or 19-9 tips.

Constant work on improvement of contour has lengthened the inspection and maintenance interval considerably from that experienced initially and, though not completely solved, this problem is well under control.

From the excellent experience with the 13 per cent chrome runner at Kemano, from a survey of European experience and practice, and from general metallurgical research all turbine manufacturers now conclude that this is the material to use for impulse runners for such high head service. Incidentally, at Kemano the water is carrying no foreign material at all, and all nozzles, throat rings, and needles are in excellent condition.

The 13 per cent chrome is a very difficult material to weld. It requires a preheat to about 600°F. and stress relieving afterwards, for major repairs so if hydraulic contours are not correct, repairs can be more difficult than with other materials.

Large 13 per cent chrome steel castings are difficult to obtain. The sources at the present time are all in Europe.

Little is known of the fatigue behaviour of 13 per cent chrome, at low stress levels, under 10,000 p.s.i., after a great number of cycles. A Kemano turbine, with an availability factor of 94 per cent runs approximately 55 million stress cycles in one month. Ordinary fatigue testing usually does not even approach this figure.

Thus certain interesting questions arise, which are being investigated by Alcan in cooperation with other organizations. In time, there may be an interesting story to tell here.

Automatic Computing for Process-Unit Operating Guides

H. F. Moore,

Esso Research & Engineering Company, Linden, New Jersey

Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June 1957

The use of computers in military applications suggests a similar computer use to optimize process operations. At present, the central office type of computer is used by the oil industry to establish running plans for process units and refineries. The extension of computer use to continuous service directly on a unit is a large step that will require considerable development. In this situation it is shown that fairly simple computers may be used directly on the operating unit to compute important operating variables that cannot be measured directly but which can be computed from other measurements — an example is furnace efficiency. Eleven such "operating guides," for fluid catalytic-cracking plants, are discussed, for which two installations are under way.

FOR SOME TIME there has been considerable discussion in technical circles about the possible use of computers to optimize oil-processing operations. This discussion is a logical outgrowth of computer success on complex military jobs such as anti-aircraft-gun control against fast-moving targets, the guiding of missiles, and the recently publicized computer system[1] that would analyze all pertinent facts in the event of enemy air attack (location and speed of enemy planes, weather data, and so on) and compute the optimum defence moves.

Considerable thought is being given to such possibilities. The intricate, large-scale, central-office-type computer is already being used in the oil industry to determine how best to run individual processing units and complete refineries, when major cost factors change. Extension of such computing to continuous service at a process unit is a very broad step. The purpose of this paper is to discuss a shorter, concrete step in this direction that is now being taken, based on oil-industry experience with automatic log-sheet printers and data-handling equipment.

Automatic Log-Sheet Printers

An automatic log-sheet printer, or "logger" as it is now termed, does automatically what the house-man of an operating crew does manually — it records a line of data on a log sheet at regular intervals, usually every one or two hours. Starting with the signals from the regular process thermocouples (for temperatures), flow-rate transmitters and pressure transmitters (pneumatic or electric type), it operates one or more electric typewriters that print out the numbers on the prepared log sheet.

A logger has many individual components that are similar to and no more complicated than conventional oil-refinery instruments: Stepping switches, pressure switches and voltage dividers. The tying together of the components into the logger results in a device which is not difficult to understand, but which does require service personnel who are specifically trained in its maintenance. Available reports on oil-industry logger installations indicate that most, if not all of them, have been installed on an exploratory basis to investigate their values and their possibilities.

Very little has been seen in the technical press about the results obtained from the refinery installations. Informal contacts and discussions indicate that many of the loggers are giving poor results. Analysis of the problems and the underlying reasons for them will make interesting reading. At the same time, it is known that good results have been obtained with other refinery installations, such that it can be said that a properly engineered, installed and serviced installation should give a service factor well over 95 per cent. Service factors over 99 per cent have been demonstrated for long periods.

Most of the incentives for automatic loggers have been intangible[2], covering such items as *(a)* obtaining data during plant upsets, *(b)* obtaining more accurate data, and *(c)* allowing accounting changes. The loggers that have worked well should now allow these intangibles to be confirmed[3]. However, for the cases studied the intangibles are elusive. This, coupled with the difficulties encountered, cast doubt on the future of loggers for process units (their future on tank farm, pilot plants and testing operations seems brighter). Something more seems needed. This something may be the extension of the logger into computing.

What is There to Compute?

Most of the refining-industry loggers have involved some computing. The orifice meter flow integrators for example, handle the equation.

$$Q = C\int_0^t \sqrt{p-p_0}\ dt$$

where

Q - quantity flow in time t, such as barrels/day

C - meter factor, based on orifice area, discharge coefficient, differential range, and so on.

p - air-pressure signal from flow transmitter.

p_0 - air-pressure signal from flow transmitter for 0 flow.

t - desired time interval, commonly 24 hr.

Compensation for pressure and temperature changes for compressible fluid flow has been included on many jobs, and a few also have included adding up all the product meters and comparing the total with the feed meter, thus giving a material balance.

Such computing is more or less accessory to the log sheet, and is little or no different from what a good operator frequently did manually. It does, however, show what might be done and opens the door to a next possible step.

Operating Guides

Often there are important variables which cannot be measured directly, but which are computed easily from measurements that are made directly. Furnace efficiency is an example common to most process units. On a fluid catalytic cracker an important example is catalyst circulation rate. Although not measurable by any normal means, it is easily computed from a heat-balance equation. To generalize, most of the guides to operation that would be computed by a process engineer (1) during plant start-up, (2) to analyze an operating difficulty or (3) to compare with design figures, can be handled by a relatively simple computer. A general name of "operating guides" is commonly used for such variables.

By using a process-unit computer with a logger, such operating guides can be made available to the non-technical operating staff on a routine basis, being printed on the log sheet with the other logged quantities. Inasmuch as cycle time has little influence on complexity of the equipment, and thus little influence on its cost, a shorter or longer printout cycle can be used for the operating guides if desirable.

Two operating-guides computer installations are under way for affiliates of the author's employing company on fluid-catalytic-cracking units. One will use digital computing equipment. The other will use electronic analog equipment, keeping all values as voltages up to the time the typewriter prints them in digits on the log sheet. One will compute eleven operating guides, the other a few additional. The number of guides to be computed had a small effect on computer cost, as it was determined that after three or four computations were included, the cost of additional related computations that could use portions of previous computations, was minor. Thus, it was possible to cover considerable extra ground for slight added cost.

Operating-Guide Calculation Examples

Two examples of the types of calculations involved in computing operating guides are given, one being quite simple and the second more complex. These two illustrate the possibilities of this technique, using relatively simple computing equipment.

Heat Duty of a Pumparound Circuit

A pumparound circuit is typified by a heat-removal circuit on a fractionation tower; a hot stream is withdrawn from the tower, pumped through heat exchangers and perhaps a water cooler, and returned to the tower. The quantity of liquid is not changed.

The equation for heat duty is of the form: Duty = flow rate x spec. heat x (temp. out - temp. in) x constant.

Catalyst Circulation Rate, in a Fluidized-Solids Circulation System

In this type of circuit the catalyst picks up heat in a regenerator, where carbon is burned off, and gives up heat in the reactor to maintain an endothermic reaction. The calculation is of the heat-balance type. The equation is of the form shown here.

$$\text{Cat. Circ. rate} = \frac{K_1(CO_2\text{ rate}) + K_2(\text{CO rate}) + K_3(\text{air rate}) + K_4(\text{flue-gas rate}) \times (\%CO_2 + O_2 + \%CO/2) - K_5(\text{air rate})\ (\Delta t_1)}{\Delta t_2 \times \text{spec. heat}}$$

$$= (\text{Btu/hr.})/(\text{deg. F. Btu/lb. deg. F.}) = \text{lb./hr.}$$

In this calculation the CO_2 rate, CO rate, air rate, and flue-gas rate are separately calculated and held in storage for use in computing two or more of the operating guides.

Value of Operating Guides

The two installations referred to are exploratory. Experience with them should establish two points: (1) Are present-day computers practicable for use on refinery-process units, and (2) what is the value to refinery operators of having frequent computations made for them of important operating variables and information not otherwise measureable?

On the first point, experience with the better logger installations indicates that with suitable design, installation and servicing, a service factor over 95 per cent is attainable. The character of the computing equipment being added to the logger equipment is not expected to change this figure. It should be noted, however, that this is much too low a service factor for important closed-loop automatic control. Distinct improvement in dependability is needed to make the use of computers in closed-loop control attractive for long-term continuous operation such as is common for oil-processing units.

On the second point, the value of operating guides to operators is a matter of opinion today. The possibility of using such information to (1) improve plant operation, (2) reduce severe upsets and (3) to recover from upsets sooner is sufficient to justify such exploratory installations. It does not require too spectacular an improvement in the operation of a process unit that is upgrading the value of its feed stream $20,000 per day (not an unusual figure in the petroleum industry) to justify an expenditure of $20,000. It is necessary, however, to demonstrate at least two things: (1) that the equipment will continue to work without the need for what has been called "resident experts," and (2) that the improvement is "real", and not so small as to be masked by normal everyday variations.

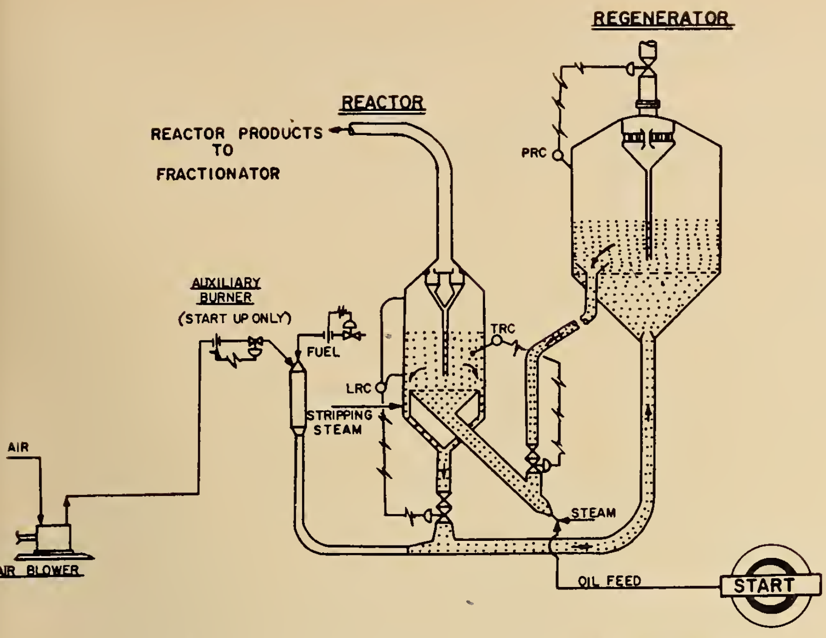
The Operating Guides

The eleven operating guides for one of the cat-cracker installations are:

(1) *Carbon burning rate,* lb/hr. This computed variable tells the operator how much carbon, which is deposited on the catalyst during the cracking reaction in the reactor, is being burned off in the regenerator.

(2) *Catalyst circulation rate.* This has been discussed.

(3) *Catalyst to oil ratio.* This is the weight ratio between catalyst circu-



Type of process unit to which automatic computing is being applied.

lation rate and oil-feed rate to the reactor.

(4) *Ratio, weight of oil fed to reactor per unit time, to weight of catalyst in the reactor.* This is a measure of contact time between oil and catalyst.

(5) *Per cent conversion of heavy feed oil to gasoline.* The feed stream is measured directly. The gasoline material is computed from several flow measurements on product and intermediate streams.

(6) *Amount of hydrogen in coke.* This is a measure of the efficiency of the stripper at the bottom of the reactor, where the oil is stripped from the coked catalyst as it is moved from the reactor to the regenerator.

(7) *Total carbon make — per cent of feed.* This is an important variable that is a measure of the effectiveness of the cracking reacton. The goal is to produce a maximum of cracked material with a minimum of carbon.

(8) *Heat duty of fractionator top pumparound stream.* This has been discussed.

(9) *Heat duty of fractionator mid-pumparound stream.* Similar to 8.

(10) *Regenerator superficial velocity.* This is a measure of velocity of gases through the regenerator.

(11) *Reactor superficial velocity.* Same as 10; for the reactor vessel.

References

1. **Life** magazine, 11 Feb., 1957.
2. "Considerations on the Reasons Which Induced Canadian Petrofina to Order an Automatic Logger," Baron de Haulleville; N.J. Section ISA Symposium, "Automatic Data Handling in the Process Industries," April 3, 1956.
3. "A Before and After Look at Data Logging," H. F. Moore; **ISA Journal**, December, 1956.

Manufacture and Metallurgy of Flash-Welded Line Pipe

M. A. Scheil, *Director of Metallurgical Research*
G. E. Fratcher, *Director of Engineering, Tubular & Process Division*
S. L. Henry, *Asst. Director, Metallurgical Research*
E. H. Uecker, *Director of Quality in Oil Field, Products & Ordnance*
A. O. Smith Corporation, Milwaukee, Wisconsin

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THE BEGINNING of resistance welding by the flash-welding process dates back to 1886, but it was not until after 1917 that it began to be developed into a practical welding method. The American Welding Society[1] defines flash-welding as a resistance-welding process wherein coalescence is produced simultaneously over the entire area of abutting surfaces by the heat obtained from resistance to the flow of electric current between the two surfaces, and by the application of pressure after heating is substantially completed. Flashing and upsetting are accompanied by expulsion of metal from the joint. The process found an increasing number of applications in the middle twenties and was well adapted for the fabrication of many articles. The process was rapidly expanded during World War II so that very critical structural forms for aircraft could be flash-welded. These included landing gears and hollow steel propeller blades.[2]

A very large production item for the company was the manufacture of 500, 1000, and 2000-lb. bomb casings from flash-welded pipe. This one item involved over 3954 miles of flash-welding medium-manganese steel of about 0.25 per cent carbon. The successful heat-treatment of these bombs to minimum mechanical properties of 70,000 p.s.i. yield strength and 105,000 p.s.i. tensile strength is further testimony to the distinct advantage of the flash-weld; namely, that by reason of its nature, no chemical composition change takes place between the weld and its parent metal and the properties that result from heat-treatment of the structure are therefore always similar. This fact has resulted in many specification bodies for our government facilities permitting 100 per cent joint efficiency for heat-treated flash-welds.

Flash-welding is used to join other metals or combination of metals which include stainless steels, copper-bearing alloys, aluminum alloys, and titanium.

This is the first of three companion papers by the same authors covering the general subject 'The Metallurgy and Cold-Temperature Testing of Flash-Welded X52 Pipe'. The other two papers, dealing respectively with Brittle Fracture in Steel, and Low Temperature Burst Tests, both related to flash-welded line pipe, will be published in the March issue of the Engineering Journal.

An outstanding example of the integrity of flash-welding is the flash-welded oil-well drill stem, fabricated by joining forged alloy-steel tool joints to drill pipe. This drill stem, working sometimes to depths below 20,000 ft., is subjected to high tensile and torsional stress, impact and abrasion. Economic success is borne out by the fact that over 50 per cent of the drill stem in service today is flash-welded.[3]

In 1926 the authors' company became interested in flash-welding as a means of joining steel. At that time the word "automation" was known only to the Greeks, but visions of this new concept already were being manifest in industries whose products were capable of being mass produced. By using new designs, we adapted the flash-welding process for making casing couplings, and the process fitted in very well with the mass produced article.

A year later the company became interested in the manufacture of large-diameter pipe. Before 1927, the total producing capacity for large-diameter pipe in the United States was about 3 miles per day. The demand for this product was growing rapidly with the oil and gas industries and in 1927 the company entered this field and by September of the same year a pipe mill was in production which had a capacity of 4 miles per day. The pipe was fabricated from a flat plate 30 ft. long which was formed to a tubular shape and then shielded-metal-arc welded. Within a year, more improvements were made and the capacity was increased to 9 miles a day. But this was not enough and in 1928 a new mill was designed to make large-diameter pipe in 40-ft. lengths. In designing the mill it was apparent that the arc-welding process was not adaptable to the economical operation planned. Since casing couplings could be easily flash-welded, there was no reason why a 40-ft. pipe section could not be welded except for the electrical power requirements. With some development work and experience, flash welders were designed and made to weld a 40-ft. length of pipe up to ⅝-in. wall thickness. To do this the electrical capacity of the flash welder had to be 6000 kva. and capable of delivering over 1,000,000 amp. to the flashing edges of the pipe.

The success of this operation was such that in the early part of 1930, all of the pipe arc-welding operations were discontinued. Since the beginning of flash-welded pipemaking the pipe-mill capacity has increased so that about 400 miles of pipe of sizes 8⅝ to 30-in. diam. can be made per month in the original plant. In addition a new plant was completed in Houston in 1950 which has a productive capacity of 200 miles per month with provisions for sizes up to 36 in. diam.

Table I.—Transverse Charpy Vee-Notch Energy 1¼ Per Cent Cold Expanded Line Pipe—30 in. x 0.500 in.

Chemical Analysis — Composition per cent						$C + \frac{Mn}{4}$
	C 0.27	Mn 0.90	P 0.012	S 0.023	Si 0.04	0.50
Testing Temperature	210°F	100°F	32°F	0°F	−50°F	−100°F
(1) Ft. lb.—Transverse Parent Metal	39	34	13	6	3	3
(1) Ft. lb.—Transverse Weld Zone	40	40	23	15	13	9
1¼% Cold Expanded Line Pipe—30″ x 0.344″						
Chemical Analysis — Composition per cent						$C + \frac{Mn}{4}$
	C 0.32	Mn 1.06	P 0.017	S 0.030	Si 0.06	0.59
Testing Temperature	100°F	32°F	0°F	−50°F	−75°F	−100°F
(2) Ft. lb.—Transverse Parent Metal	23	10	6	3	3	3
(2) Ft. lb.—Transverse Weld Zone	26	25	16	10	8	8
1¼% Cold Expanded Line Pipe—30″ x 0.375″						
Chemical Analysis — Composition per cent						$C + \frac{Mn}{4}$
	C 0.28	Mn 0.88	P 0.018	S 0.034	Si 0.04	0.50
Testing Temperature	210°F	100°F	32°F	0°F	−50°F	−100°F
(2) Ft. lb.—Transverse Parent Metal	26	23	10	9	4	2
(2) Ft. lb.—Transverse Weld Zone	26	26	25	20	10	8

(1) Standard size Charpy—0.394 x 0.394″
(2) 2/3 Standard size Charpy—0.262 x 0.394″

No history of a process would be complete without some facts and figures. As we often say, "the record speaks for itself." Flash-welded tanks of gauges 0.088 to 0.110 in. of mild steel for our glass-lined water heaters are a sizable item and have amounted to 2700 miles of flash welds.

We are rightly proud of the service record established over 30 years by the 42,000-odd miles of pipe laid to date, the greatest percentage of which is 20 in. and larger thin-wall pipe for high-pressure trunk-line service. Fig. 1 is a bar graph of the total mileage for the different sizes produced through 1956.

We can add a substantial tonnage to the foregoing for high-strength oil-well casing and other tubular products made by flash-welding which gives us an extensive and varied experience that justifies confidence in the safety, reliability, and economy of flash-welded line pipe.

Process of Line-Pipe Manufacture

Pipe manufacture begins in the

Fig. 1 (left). Line pipe production — miles of pipe of each size produced from 1927 through 1956.

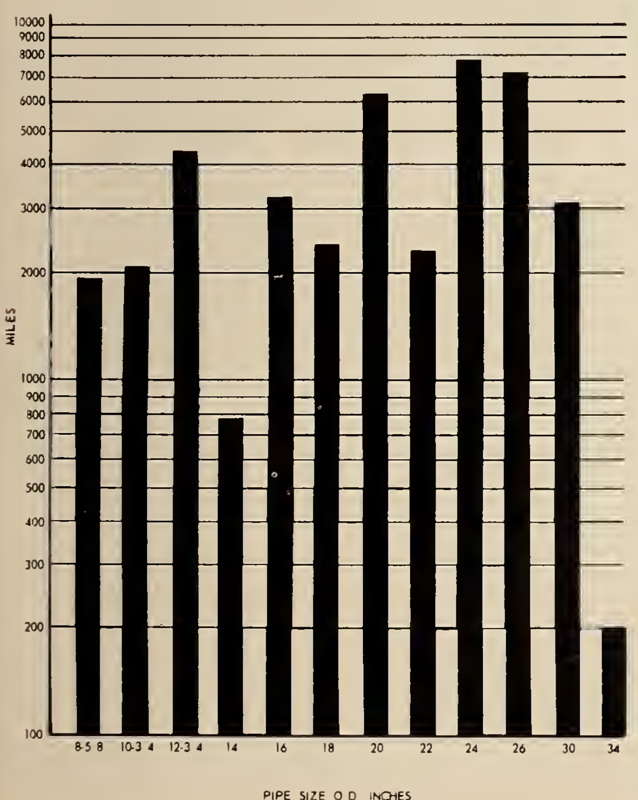


Fig. 2. Research and Engineering Building — A. O. Smith Corporation, Milwaukee Works.

Fig. 3. Spectographic equipment in research laboratories.

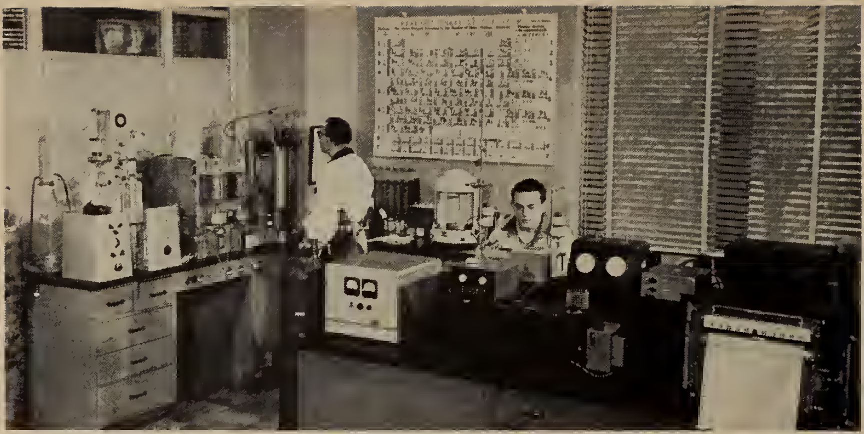


Fig. 4. Extremely sensitive carbon combustion analytical apparatus (in background) and spectrophotometer apparatus (foreground).

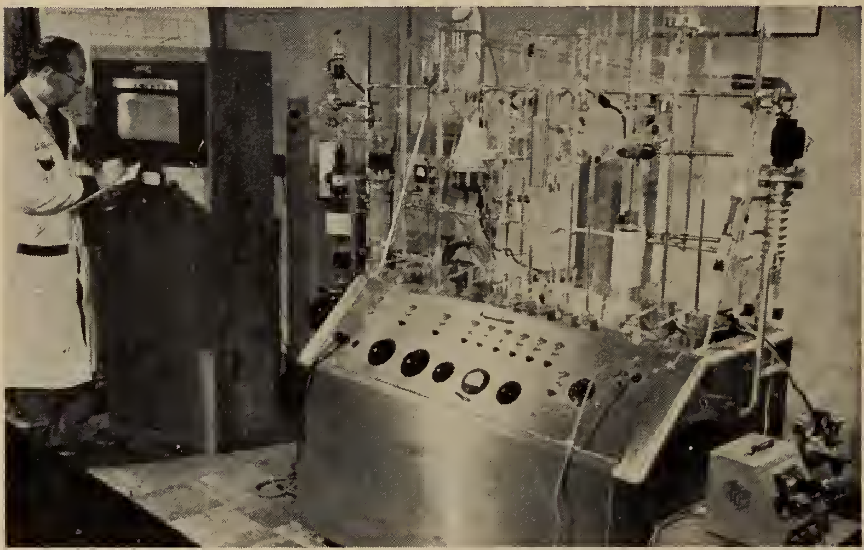


Fig. 5. High-vacuum equipment for gas analysis and oxide analysis of line-pipe steel.

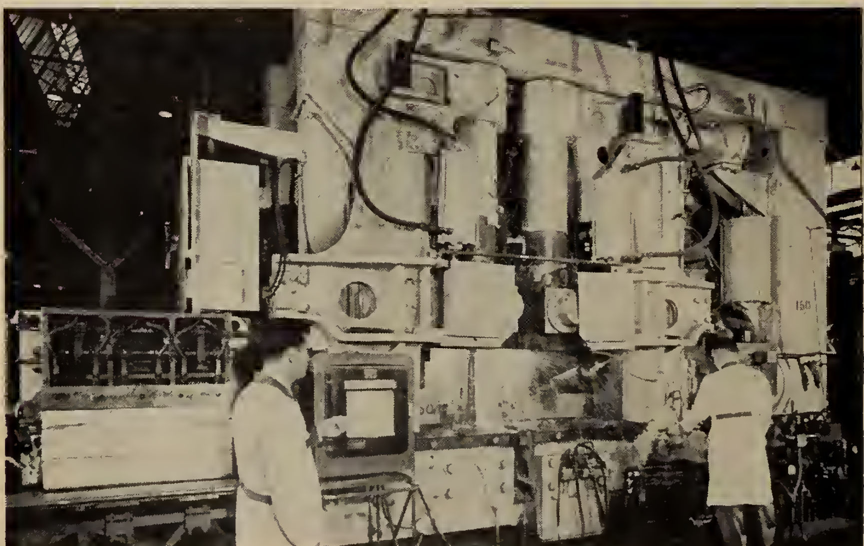


Fig. 6. Fifty-square-inch flash-welder for research welding.

laboratories of the research and engineering building with facilities for investigating every facet of line-pipe manufacture and end use. A few of our laboratories are regularly used to maintain quality and uniformity of line pipe. Fig. 2 shows the research and engineering building.

A view of the spectrographic and analytical chemical laboratories is shown in Figs. 3 and 4. Residual elements are periodically determined for the many sources of steel.

Another important research apparatus shown in Fig. 5 is the vacuum-fusion equipment for gas analysis and the fractional vacuum-fusion analysis of oxides in steel. The analysis from this equipment tells us about the deoxidation products remaining in the steel and is a valuable tool in evaluating the metallurigical behaviour of our materials.*

An experimental flash welder equipped with ultrasensitive electronic controls and variable pressures for burn off and bump is used in a continuous study of flash-welding research. Fig. 6 is one of these machines designed for 5-sq.-in. welding capacity with 2500 kva. power capacity.

The welding research laboratories together with metallurgical research are two of the oldest in our company. Their facilities encompass a complete laboratory for manufacture and testing of covered-metallic-arc-welding electrodes, all types of welding machines for automatic fusion welding in gas-protected atmospheres and the metallurgical testing equipment necessary to study and evaluate the processes.

Fig. 7 is a polariscope used to study and rate stresses in plastic models. Next to the Brinell hardness tester we consider this equipment and its value to engineers in design as one of the most valuable tools in our laboratories.

Fig. 8 is a corner of the research welding electrode laboratory. In earlier days this laboratory produced the first coated electrodes used to weld line pipe in the field and has contributed much to the recent developments.[4]

Figs. 9 and 10 show some of the mechanical testing equipment used

*An excellent discussion to A. B. Wilder's paper (reference (5) of the bibliography of the second companion paper) on the effect of deoxidation and its influence on the toughness and ductility of steel is given by A. Hurtgen, Henry Vogt Machine Company, and G. H. Enzian, Jones & Laughlin Steel Corporation.

to determine accurately the stress-strain characteristics of steel. The Instron testing machine in Fig. 9 has low load ranges of testing with maximum capacity of 10,000 lb. and a minimum full-scale load of 20 grams. The wide range of loads is facilitated by changing its strain-gauge-type load cells. Its electronic-amplifying system permits the selection of several load ranges within one load cell.

The selsyn-controlled mechanical-drive system moves the crosshead at a maximum of 20 in. per min. and a minimum rate of 0.02 in. per min. The recorder chart can be driven by time, microformer, extensometer or by a strain gauge mounted on the specimen, making it a complete X-Y recorder. Various controls permit automatic cycling, by load or deflection, and zero suppression.

The elevated temperature-stress rupture equipment shown in Fig. 10 is used entirely in this laboratory to study the long-time strength and ductility characteristics of weldments above room temperature. There has been very little work of this nature reported in the literature.

Fig. 11 shows some of the larger fatigue testing equipment used to test welded structures in vibration. The setup shown is that used to test a flash-welded propeller blade for the B-36 airplane.

Pulsating hydrostatic fatigue tests

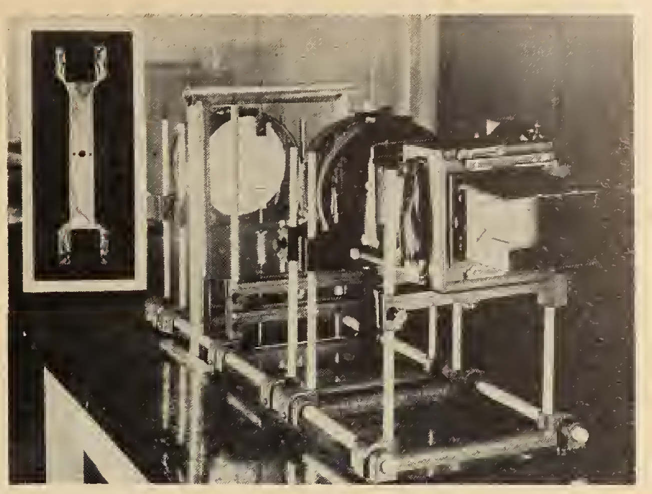


Fig. 7. Polariscope for investigating stress patterns in plastic models.

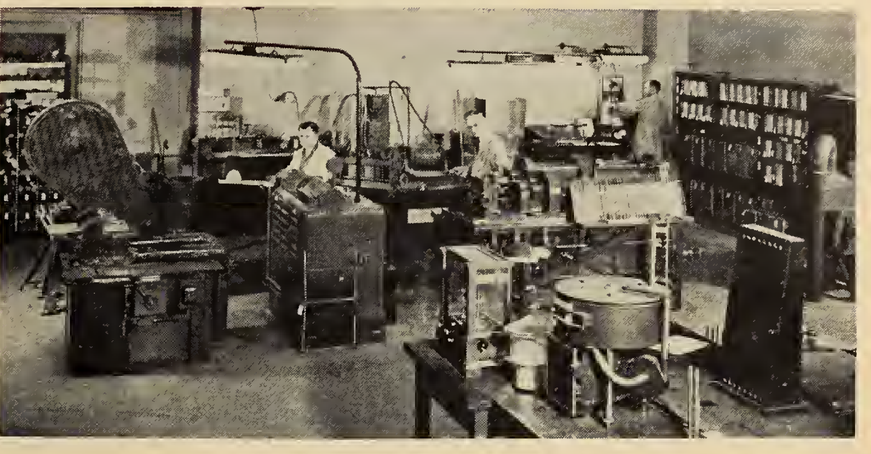


Fig. 8. Equipment for making experimental shielded-metal-arc electrodes.

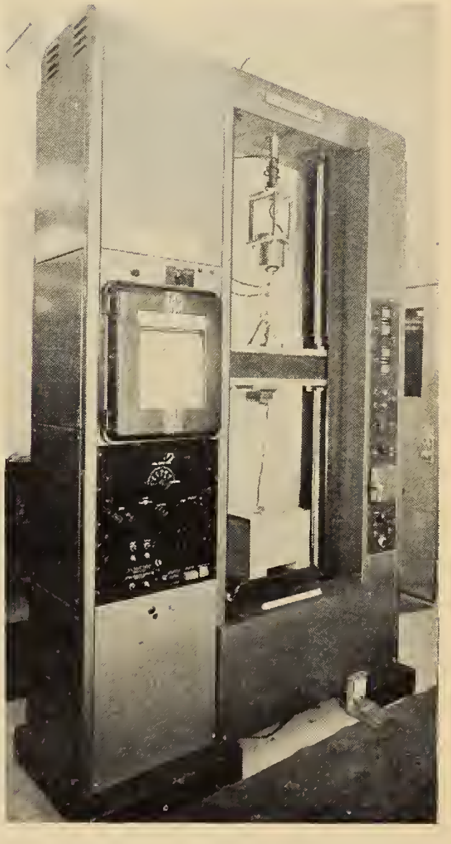


Fig. 9. Instron testing machine — — reinforced plastics research laboratory.

Table II.—Mechanical Properties of Cold Expanded Pipe, 30 in. x 0.375 in.

Chemical Analysis — Composition per cent

C	Mn	P	S	Si	C + Mn/4
0.24–0.28	1.04–1.12	0.011–0.015	0.031–0.040	0.03–0.04	0.52–0.54

Transverse Mechanical Properties: After Expansion of 0%, 1¼% and 2¼%

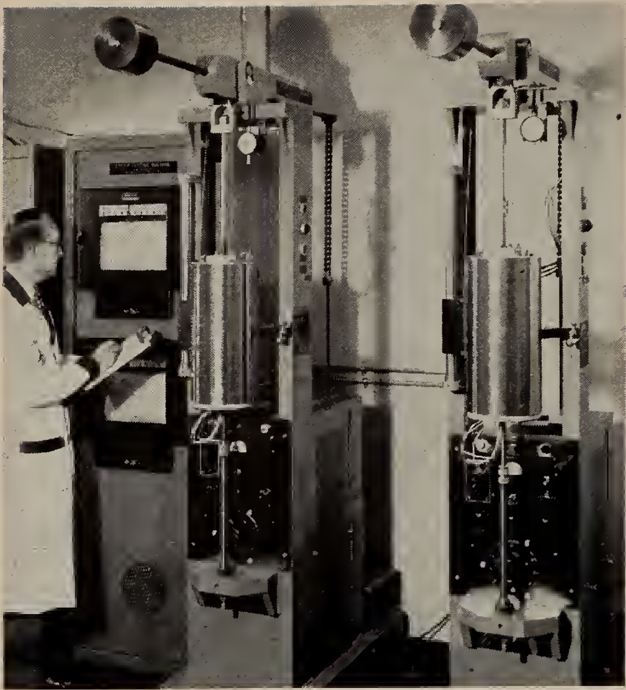
	Yield Strength (2) p.s.i.	Tensile Strength p.s.i.	% Elong. in 2″	Hardness Brinell
0% Expansion				
Across Weld*		84,400		166
90° from weld	58,800	80,500	35.5	166
180° from weld	61,900	81,400	33.5	166
1.25% Expansion				
Across weld*		82,300		166
90° from weld	61,100	81,900	32.5	166
180° from weld	63,600	86,600	28.5	170
2.22% Expansion (1)				
Across weld*		87,300		170
90° from weld	63,800	84,800	33.0	170
180° from weld	66,400	85,000	32.0	174

Charpy Vee Notch Energy of Parent Metal—3/4 Standard Size 0.297″ x 0.394″

Testing Temperature	210°F	150°F	75°F	32°F	0°F	−20°F	−40°F
0.00% Expan. ft. lb.	30	30	19	13	11	8	5
1.25% Expan. ft. lb.	22	21	12	5	4	2	2
2.22% Expan. ft. lb. (1)	25	26	15	11	7	5	9

(1) Results obtained from a separate 40-foot length of pipe of similar chemical analysis: C 0.24%, Mn 1.20%, P 0.030%, S 0.030%, Si 0.03%, C + $\frac{Mn}{4}$ 0.54.

(2) 0.5% elongation under load. Specimen 1½″ wide.
* Fracture at edge of weld reinforcement.



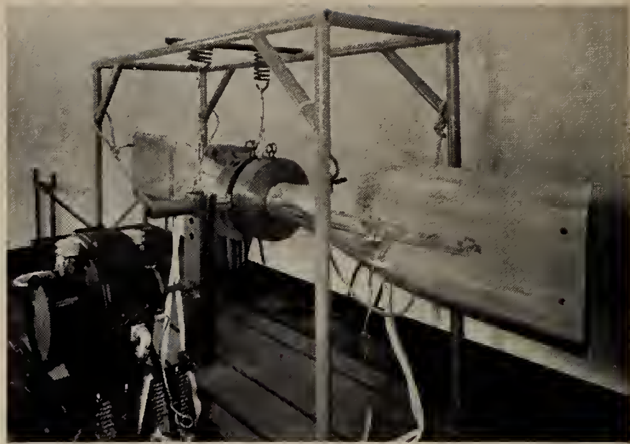


Fig. 10 (above, left). Elevated-temperature testing apparatus to determine stress-rupture properties of weldments.

Fig. 11 (above, right). 500-pound-force vibrator used in fatigue tests of welded structures.

Fig. 12 (below, left). Hydrostatic test of a welded branch-line connection. Electric strain gauge setup to study stress developed during test.

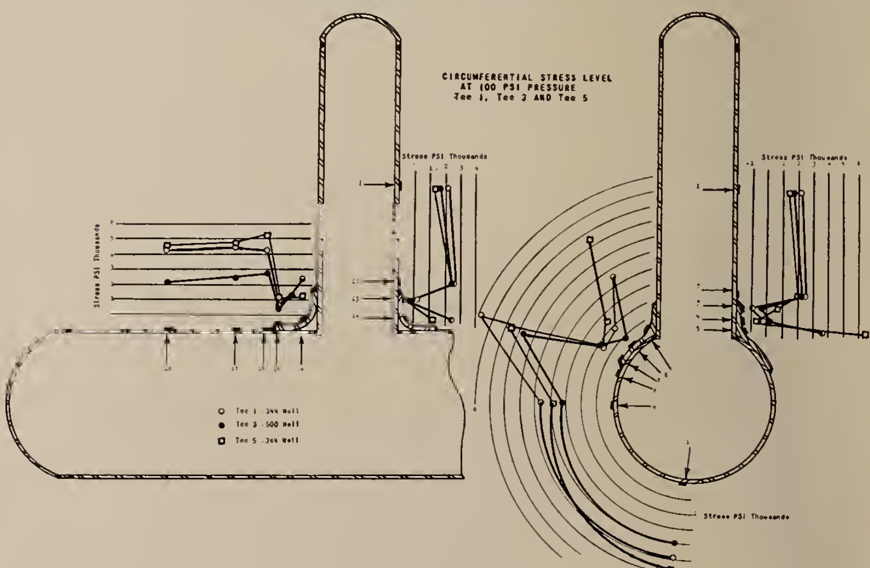
Fig. 14 (below, right). Hydrostatic burst test of branch-line connection.

have been performed by others[5] on commercial flash-welded lengths of line pipe. One fabricator of branch-line connections reported over 535,000 successful cycles of stress on 22-in. x 0.312-in. pipe between 35,200 and 58,100 p.s.i. hoop stress on our pipe with a minimum yield-strength requirement of 52,000 p.s.i.*

We use fatigue testing in proving design and rating the quality of weldments for service conditions involving fatigue action.

Our laboratories are completely equipped with all the latest facilities for inspection by non-destructive methods for flaws and for stress

Fig. 13. Circumferential stress levels calculated from strain-gauge readings on branch-line connection.



*Mechanical properties of 22-in. x 0.312-in. line pipe: 63,800 p.s.i. yield strength, 89,000 p.s.i. tensile strength, 88,400 p.s.i. joint tensile strength across flash weld. Chemical composition: C, 0.28; Mn, 1.12; P. 0.022, S. 0.015; Si, 0.02 per cent.

measurements to evaluate structures from an engineering viewpoint.

In studying the efficiency of reinforcements for branch-line connections in co-operation with a large distributor of natural gas, we recently conducted a study of several engineering designs with the use of strain gauges to record the stress pattern while the welded structures were pressurized. Fig. 12 shows a typical setup for strain-gauge study and Fig. 13 shows the results obtained in calculating to stress, the readings obtained from strain-gauge study. Fig. 14 shows the burst test which indicates failure at the location of highest stress predicted from the strain-gauge survey.[6]

The actual operations involved in the manufacture of flash-welded line pipe are best illustrated in the schematic outline of Fig. 15.

Fig. 16 shows the acid cleaning of the plate steel in controlled baths: first, a pickling with inhibited acid to rot the mill scale, then a water rinse, then a neutralizing in an alkaline bath, followed by a hot water rinse. This assures a clean surface for inspection of the pipe.

Fig. 17 shows the cleaned, inspected plate being simultaneously flattened and scarfed.

Fig. 18 shows the forming operations which require three separate presses. The sketch in Fig. 18 shows each forming shape from flat plate to round pipe. Figs. 19 and 20 show forming equipment at our Houston plant. The press shown in Fig. 20 is 16,000 tons capacity for closing the pipe to a round. Fig. 21 shows two flash welders at our Houston plant and Fig. 22 shows the three flash welders at Milwaukee plant. The entire 40-ft. length of pipe is flash-welded simultaneously and the operation being largely automatic, uniformity of the weld is assured.

The welding process produces an upset on the inside and outside surfaces of the pipe and in the next operation this flash is removed by a series of cutting tools from both the inside and outside as in Fig. 23.

Fig. 24 shows the end facing after expanding.

Internal expanding offers three advantages for the pipe: *(a)* The internal expansion provides a test of the weld, *(b)*, it increases the yield strength of the pipe in the hoop direction, and *(c)*, it produces uniformity of physical dimensions by accurate straightness and roundness.

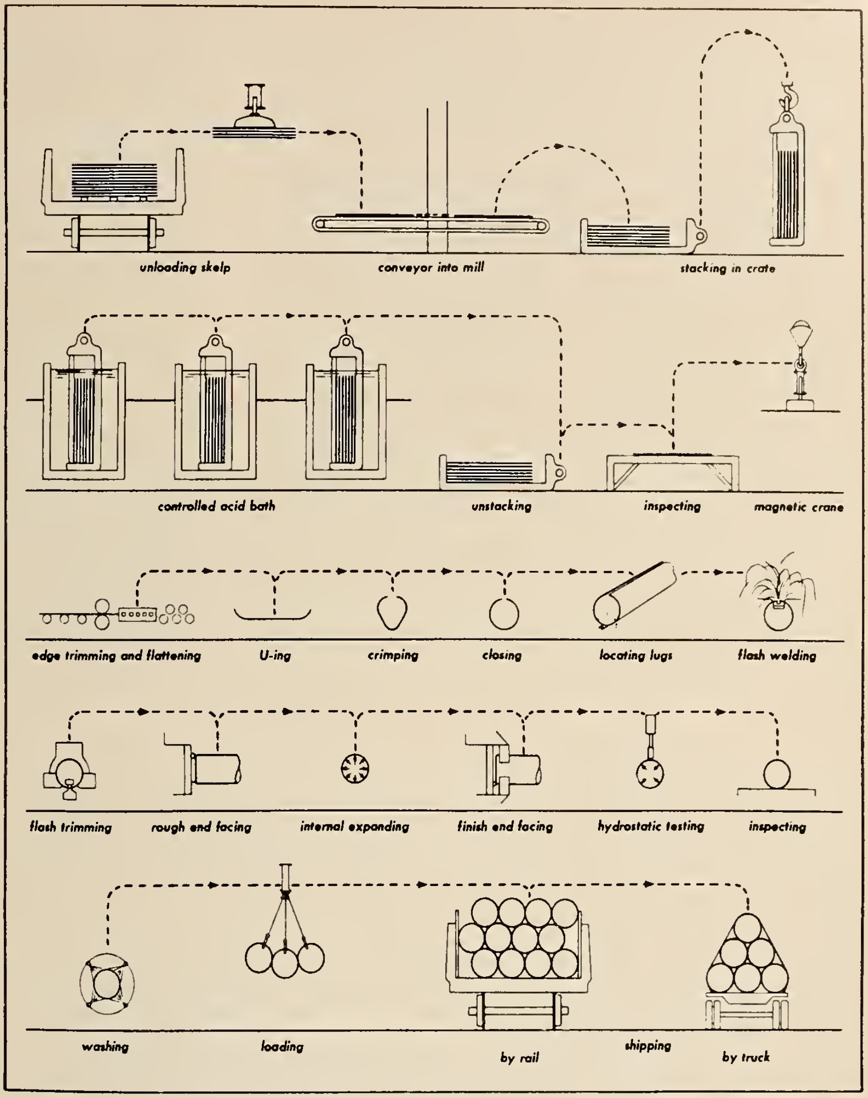


Fig. 15. Line-pipe production flow chart.

Fig. 16. Pickling operation on line-pipe skelp assures clean surfaces with no hidden defects for line-pipe manufacturing.

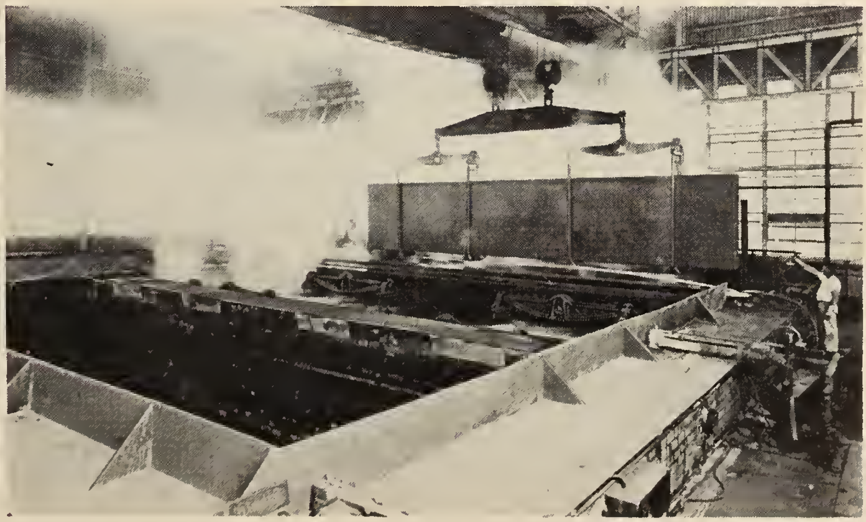


Fig. 25 shows the latest development of internal expansion of large-diameter pipe by means of a special expanding tool. Expansion by this process assures uniform inside diameter throughout the length of the pipe without any scratching, gouging, or maltreatment of the ID surface. After internal sizing, the pipe is faced on both ends, Fig. 26, to the bevel or contour of API Standard 5L or 5LX and then moves into the final testing machine.

The final hydrostatic test, shown in Fig. 27, is performed at a pressure of at least 90 per cent of the specified minimum yield strength for 20-in-OD and over line pipe, or as may be called for by API specifications. While under full test pressure, repeated blows are struck directly on the weld by 6½-lb. hammers placed at 2-ft. intervals along the weld area. Following the hammer test, the pressure is reduced 50 per cent while the inspector examines the entire length for leakage before certifying the soundness of the weld.

Inspection follows hydrostatic test where the inside and outside surfaces and dimensions are checked carefully. Fig. 28 is a view of the inspection area. The weight and length are recorded.

Final cleaning of the pipe is through a washing machine which uses hot alkali solution to remove any grease that may have accumulated during manufacture. The size, length, and weight are paint stenciled on the pipe and at this point the pipe is given a final visual inspection by company inspectors and by the customers' representative.

Fig. 17. Continuous operation of flattening plate and machine scarfing of edges for welding.

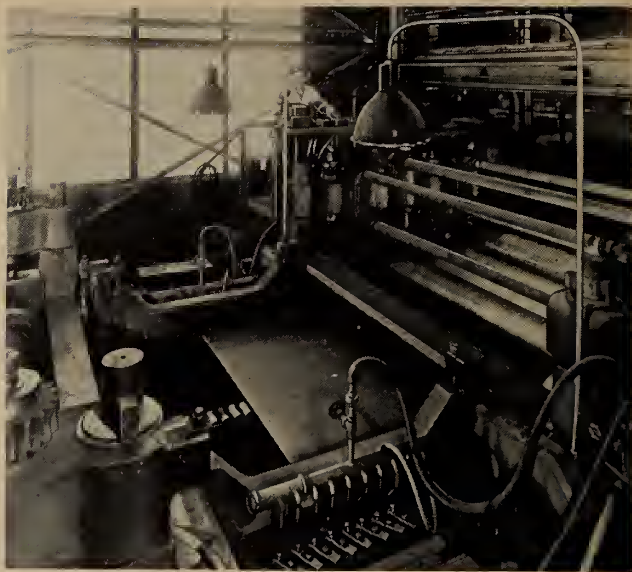
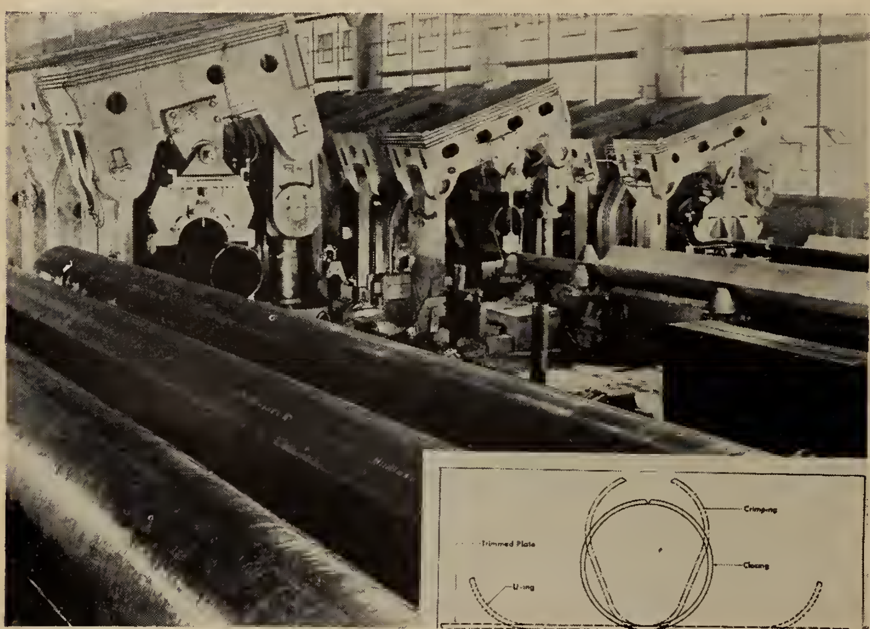


Fig. 18 (below). Forming operations for line pipe U, crimp, and closing prior to flash-welding.



The finished pipe is conveyed on to a loading platform and deposited in a gondola car according to procedures that have been worked out from experience. Fig. 29 shows diagrams for loading 16 to 30-in-diam pipe. For a more detailed description of large-diameter line-pipe manufacture the reader is referred to recent articles by W. C. Hoppe.[7,8]

Bending in the Field

With the advent of high-strength line pipe in 1941, cold instead of hot bending was developed as a means of retaining the high-strength properties imparted through cold-working. Three general techniques now account for virtually all field bending — cold wrinkle bending, cold bending in a bending block, and the more recent cold-stretch bending. All three bending methods have been tested extensively and used on thousands of miles of line pipe, to the complete satisfaction of the operators. Figs. 30 and 31 show two views of cold field bending.

Layer-Wrapped Pipe

For high-pressure submerged applications such as river crossings and offshore high-pressure gas lines, our layer-wrapped pipe is now being used to meet problems occasioned by abnormal operating pressures and conditions.

Layer-wrapped pipe is pipe that has been strengthened by adding an outer layer of steel. It provides the heavier wall thickness needed to resist higher pressures and, where used for river crossings, it provides additional, uniformly distributed weight which reduces buoyancy.

Fig. 32 shows several sections of wrapped pipe for a submerged, high-pressure 20-in-diam line from offshore gas wells.

Metallurgy of the Flash Weld

The literature pertaining to the metallurgy and mechanical properties of flash-welded joints in steel and alloys of iron are of rather recent origin and the reader is referred to one of the more up-to-date articles by Dr. Hans Kilger and Prof. E. Nippes at Rensselaer Polytechnic Institute.[9]

For the purposes of this paper we will mention only some of the fundamentals of metallurgy in flash-welding semi-killed medium manganese, 0.20 to 0.30 per cent carbon steels

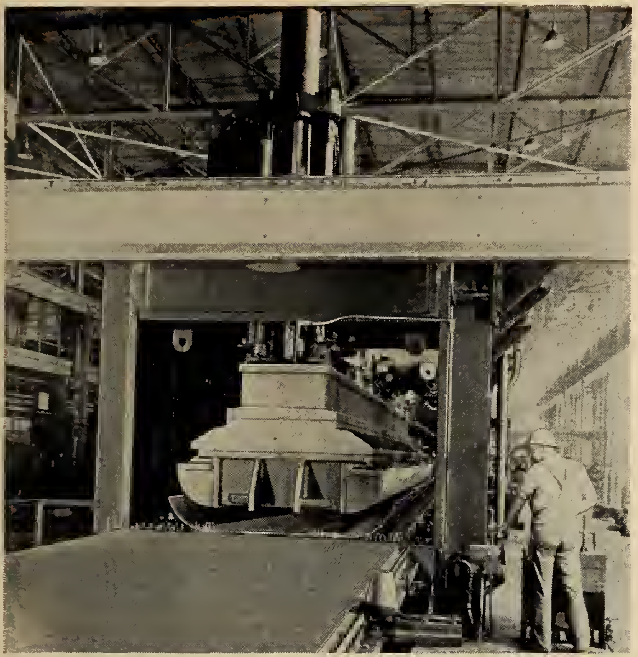


Fig. 19. Initial forming press for line pipe at Houston plant.

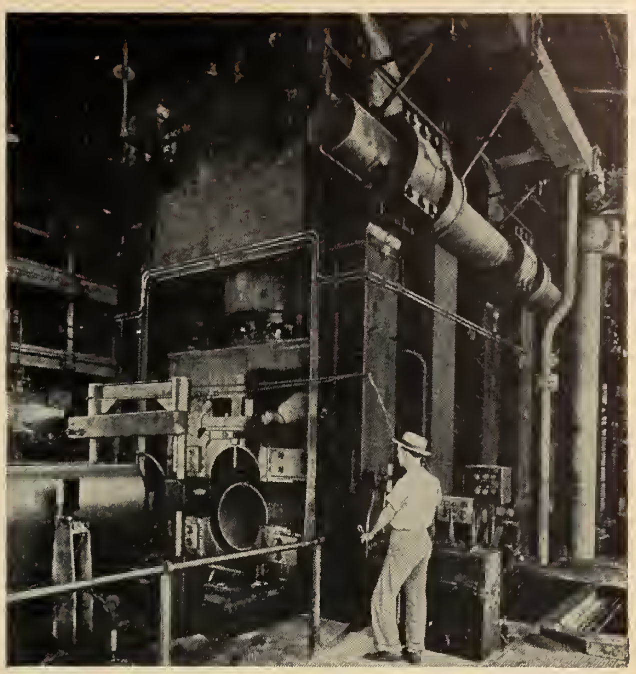


Fig. 20. 16,000-ton closing press for line pipe at Houston plant.

which are of the type generally in use for expanded 5LX Grade X52 steel line pipe.

In the manufacture of a flash-welded joint the edges to be joined are brought to a semi-liquid state by a flashing action caused by the passage of electrical energy between the contacting surfaces. Just before the current is cut off the two edges are bumped together automatically, thus making the weld. By this process a predetermined amount of metal together with the oxides formed by heating are squeezed out, resulting in a clean, sound, and strong union.

Fig. 33 shows a polished cross section of the as-welded condition of a line pipe weld as we produce it. The structure is brought out by a light etching of the polished surface.

The photograph shows a graduation of heat into both sides of the parent metal. It is observed that the grain size is slightly coarser near the center of the weld and blends with

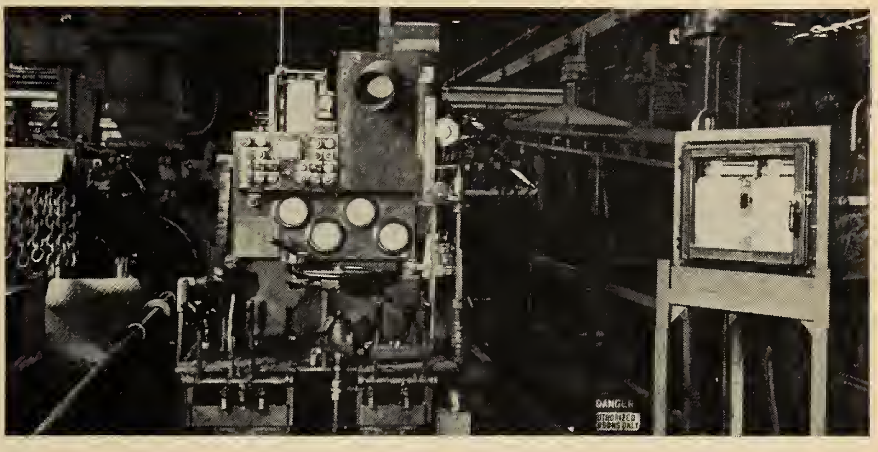
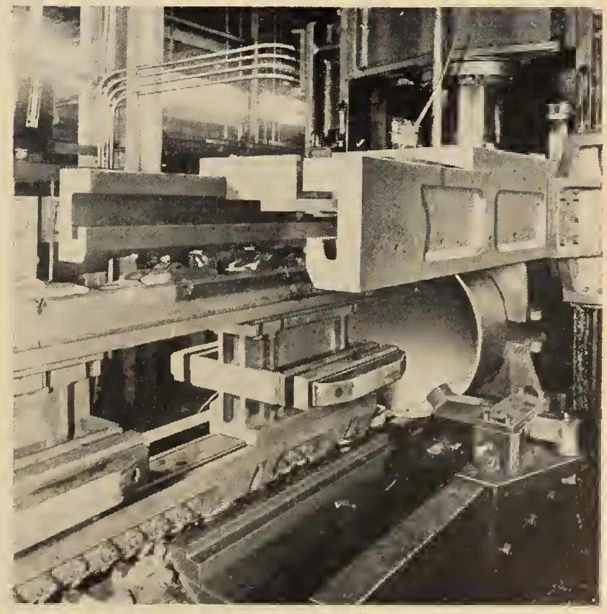


Fig. 21 (above). Pipe flash-welders with capacity to 36 in. diam. at Houston plant.

Fig. 22 (below, left). Pipe flash-welders with capacity to 30 in. diam. at Milwaukee plant.

Fig. 23 (right). Flash-trimming operation.



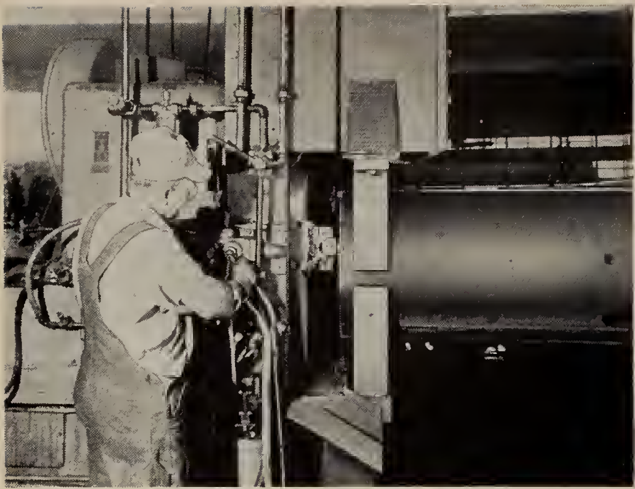


Fig. 24. End facing after mechanical expanding operation.

Fig. 25. Internal mechanical expanders.

weld zone* shown in Fig. 35 indicates very little change in hardness and therefore no decrease or increase in the tensile strength of the metal after the flash-welding process.

The rapid cooling of the flash-weld zone produces a normalized grain structure with no change in tensile strength but with an increase in the yield-strength property. This increase in yield strength in the flash-weld zone is best illustrated by the results of strain measurements on a 40-ft. length of flash-welded and trimmed 30-in. x 0.375-in. line pipe made during internal mechanical sizing to 1¼ per cent circumferential expansion:

(1) Circumferential permanent expansion of the stock was uniform varying from 1.14 to 1.40 per cent. The average of nine strain-gauge readings along the length of pipe was 1.27 per cent.

(2) Longitudinal permanent contraction of the stock varied from 0.24 to 0.38 per cent. Shortening of 30-in-OD line pipe after cold internal mechanical sizing on a 40-ft. length is about 2¼ in.

the parent metal out to the contact saddles where the water-cooled electrical contacts together with the mechanical contacts actuate the pipe during flashing and the welding bump.

Both surfaces of the weld show a flash of hot extruded metal.

During the flash-trimming operation, the weld flash is removed from both the inside and outside simultaneously to within 1/16 in. or less of the pipe surface. The finished trimmed flash-weld, now ready for service, appears as in Fig. 34.

A hardness survey across the flash-

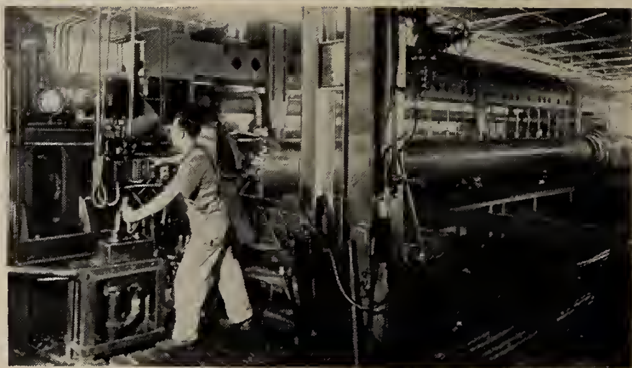


Fig. 26. End facing to required bevel for field welding.

Fig. 27. Final hydrostatic test of line pipe.

Fig. 28. Final inspection of line pipe after hydrostatic testing (left).

*The weld zone in a flash-weld is defined as the material which has been heated above the transformation temperature.

(3) The weld area of a cold expanded pipe is under residual compression in the longitudinal direction because of the relatively greater yield strength of the flash-weld zone. The residual compression stress in the weld zone is 30,000-35,000 p.s.i. in the longitudinal direction. This could be considered to be a built-in safety factor against fatigue damage in service as well as shock or pulsating loading.

(4) The combination of the forging action and controlled normalizing heat-treatment obtained from the simultaneous heating and automatic welding of the 40-ft. pipe welds in our flash-welding process improves the toughness characteristics of the steel in the weld zone over that of the parent metal.

As an example of this effect the Charpy vee-notch-energy values are compared in Table I at different temperatures. The data shown are an average of three Charpy tests at each location and temperature.

From the data it will be observed that the weld zone has a transition temperature at 10 ft-lb energy* of minus 50°F. whereas the parent metal has a transition temperature of +32°F. This improvement of the weld-zone notch toughness, over the parent metal is not due entirely to the normalizing heat-treatment, as we have determined that under the best heat-treated conditions, it is not possible to bring the parent metal to a state of notch toughness, as determined by Charpy impact data, to duplicate the properties in the weld zone. The observed improvement then must be due to a combination of high-velocity hot-forging impact followed by controlled rapid cooling which prevents a coarse "blocky" ferrite structure formation.

Fig. 36 is the macrostructure of the same line-pipe flash weld shown in Fig. 33 after a full annealing heat-

Table III.—Evaluation for X52 Grade Steel

Code No.	Longitudinal, ft.-lb.	Transverse, ft.-lb.	Ratio L/T
1	34	19	1.79
2	39	23	1.70
3	41	17	2.41
4	25	18	1.39
5	35	23	1.52
6	42	18	2.33
7	32	15	2.13

Table IV.—Mechanical Properties of Expanded Line Pipe After 25 Years of Service

Check Chemical Analysis

C	Mn	P	S	Si
0.21	0.58	0.016	0.036	0.03

The steel was of semi-killed quality.

TENSILE PROPERTIES

Transverse Direction

Yield strength: 48–50,000 p.s.i. (0.2 per cent offset)
Ultimate tensile strength: 72–74,000 p.s.i.
Per cent elongation in 2 in.: 26.5–31.5
Brinell hardness: 153–156
Across oxyacetylene field girth weld with reinforcement left on:
Yield strength: 44–44,600 (0.5 per cent stretch)
Ultimate tensile strength: *51,300–71,500 p.s.i.
* Specimen with low tensile fractured in weld due to porosity penetrating into cross section approximately 1/8 in.

Longitudinal Direction

Yield strength: 46–46,500 p.s.i. (0.2 per cent offset)
Ultimate tensile strength: 68–69,000 p.s.i.
Per cent elongation in 2 in.: 35.5–37
Brinell hardness: 153
Bend test result, longitudinal weld: Face and root bends were satisfactory to 180°
Charpy vee-notch tests—3/4 standard size 0.297 in. x 0.394 in.—transverse

Temperature	32F	60F	90F
Ft. lb.	4.5	6.0	11.8

Note: The above values are the average of five separate tests.

Charpy Vee-Notch Tests—1/2 Standard Size—0.197 in. x 0.394 in.

Test temp., deg. F.	Transverse direction, ft.-lb.	Test temp., deg. F.	Longitudinal direction, ft.-lb.
−30	1.0–1.5	−40	1.0–1.5
0	1.5–2.0	0	2.0–2.5
+32	2.0–7	+32	2.0–6.7
+50	5–8	+50	5.5–12
+80	15–19	+80	20–27
+130	20–22.5	+150	27–29
+212	24–25	+212	30–32

*The U.S. Naval Research Laboratory has proposed 10 ft lb Charpy vee notch as the criterion for minimum service temperature when using steel of rimming or semi-killed quality.

Fig. 29. Diagrams for loading 16 to 30-in.-diam. pipe.

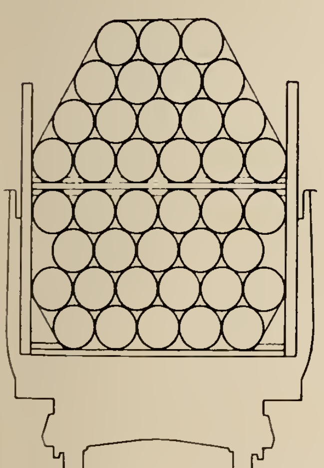


Diagram A—Typical car loading for diameter up to and including 16″ using stakes and tied in two units.

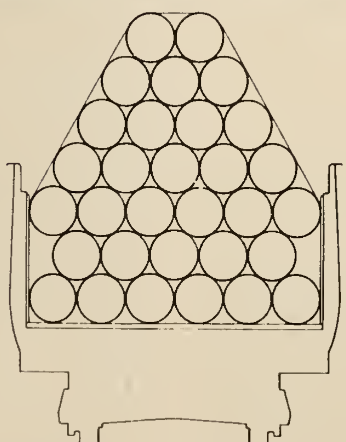


Diagram B—Typical car loading for pipe diameters 18″ to 26″ inclusive, tied in one unit without stakes.

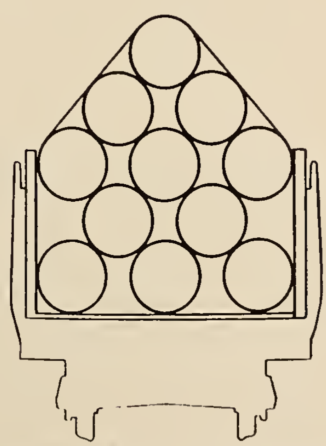


Diagram C—Typical car loading for 30″ diameter pipe, tied in one unit and using stakes when needed.

treatment purposely given to bring out the flow pattern, by etching, of the metal after the welding bump.

It will be observed that the direction of metal fibre or flow, so important to the strength of forgings, is gradually and uniformly turned about 90 deg. This flow pattern is evidence of a high-velocity hot forging impact causing the removal of any impurities at the semi-liquid surfaces of the 40-ft. length which are brought together simultaneously and automatically.

It will be observed from Table II that controlled cold expansion by mechanical internal sizing in small amounts is beneficial to the mechanical properties of the steel and the flash weld.

It has been our experience with over 42,000 miles of flash-welded line pipe in service, that the metallurgical properties of a simultaneously flash-welded tubular product of steel can be likened to high-quality closed die forgings. Every closed die forging has a flash line to permit the hot steel to fill the die cavity properly and as a result flow lines are generated in the extruded metal. Superior advantages for flash-welded tubes over hollow-forged or pierced cylinders are evident in a comparison of the surface condition. The skelp used for the flash-welded tube must first be rolled to proper width and length from its billet or slab and in this process the cross rolling benefits the mechanical properties in the transverse direction.

For example, taking the data of the Armour Research Foundation[10] report on welded X52 grade steel line pipe and averaging the 2/3 standard Charpy vee-notch data at 80°F. for the longitudinal and transverse direction on 53 heats of expanded line pipe resulted in the evaluation given in Table III for X52 grade steel.

Fig. 30. On-the-spot cold field bending of 26-in.-OD line pipe.

Since flash-welded line pipe is made from carbon-steel plate (skelp) purchased to rigid specifications the steel possesses the desirable surface smoothness and density characteristic of rolling, and both inside and outside surfaces can be inspected thoroughly for flaws and imperfections before manufacture into line pipe.

Metallurgical Analysis of Expanded Flash-Welded Line Pipe (24 in. x 0.344 in.) in Service 25 Years

An opportunity was provided recently to examine a piece of 24-in. x 0.344-in. flash-welded line pipe manufactured in 1930. The pipe had been joined in the field with oxyacetylene welds at the girth seams. Internal sizing had been performed with hydrostatic pressure. The average carbon analysis was 0.23 per cent, the average manganese was 0.61 per cent. Average transverse strip tensile across the weld and stock averaged 47,733 p.s.i. yield strength at approximately ½ per cent stretch and the ultimate tensile strength averaged 68,640 p.s.i. The average elongation was 19.29 per cent. The results of several burst tests averaged 46,160 p.s.i. at yield and 63,820 p.s.i. ultimate tensile strength. These tests were performed when the pipe was fabricated in 1930. The pipe was manufactured to minimum properties of 60,000 p.s.i. tensile strength and 30,000 p.s.i. yield strength.

After approximately 25 years of service this pipe was removed and retested by the customer. One of the line pipes was field tested to a pressure of 1700 p.s.i., which corresponds

Fig. 31. Tough bend requirement met with 26-in-OD line pipe.

Fig. 32. Installation of wrapped pipe for submerged, high-pressure line.

Fig. 33. Etched structure of an as-welded line-pipe flash-weld.

Fig. 34. Trimmed flash weld of a line pipe.

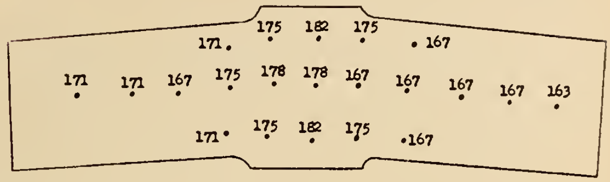
to a circumferential stress of 60,000 p.s.i., or the minimum guaranteed ultimate tensile strength of the steel, "as fabricated". One reason for the work being done was to prove or counteract rumors that pipe which had been cold internal expanded and which had been in service for a long period of time becomes brittle and dangerous for future use.

It is not the purpose here to discuss the quality of the welding, which, it was evident, was far inferior to anything produced at the present time, in the matter of field girth seams, and it is not the purpose here to detract by reason of this evidence any demand for the highest quality field welding demanded today for pipe-lines.

However, the authors believe it would be of interest to review Table IV showing the mechanical properties that were determined after 25 years of service on this 1930 vintage expanded 24-in. x 0.344-in. wall flash-welded line pipe.

Based on a 10-ft.-lb. value of the ½ standard Charpy vee-notch bar a transition temperature of approximately +50 deg. F. is obtained. The grain size of the material based on the ASTM carburizing test was found to be 5-7 and would be classed fine grained.

As a result of these tests, it was concluded that the material did not embrittle or deteriorate in mechanical strength properties in the 25 years of service.



16 in. x .250 in. Line pipe as welded

Fig. 35. Hardness survey of a flash-weld in line pipe.

Vickers Hardness Number		Estimated Tensile Strength Psi	
Parent Metal	Weld Zone	Parent Metal	Weld Zone
171 Max. 163 Min. 168 Ave.	182 Max. 175 Min. 177 Ave.	79,000 Max. 73,000 Min. 77,500 Ave.	85,000 Max. 81,000 Min. 82,000 Ave.

Chemical Analysis C - 0.25 Mn - 1.14 S - 0.026 P - 0.015 Si - 0.04

Fig. 36. Etched structure of a flash-weld annealed to show metal fibre or flow.

References

1. "Welding Handbook," third edition, American Welding Society, New York, N.Y., 1950.
2. "Ten Years of Development Work Preceded Welded High-Strength Bomb," M. A. Scheil. Address at Joint Meeting ASM and AWS; **Metals Review**, April, 1948.
3. "Fatigue Testing and Development of Drill Pipe to Tool Joint Connections," W. S. Bachman; **World Oil**, January, 1951.
4. "The Development of Metal Arc Electrodes for Special Welding Applications," R. J. Keller; ASME Paper No. 51-PET-2.
5. "Pressure Pulsation Tests of Branch Connections to Large Diameter Pipe," A. R. C. Markl, H. H. George, and E. C. Rodabaugh; Gas Supply, Transmission and Storage Conference, May, 1955, American Gas Association.
6. "Welded Tee Connections," A. G. Barkow and R. A. Huseby; Welding Research Council Bulletin Series, Bulletin No. 22, May, 1955.
7. "Large Diameter Line Pipe," W. C. Hoppe, **Mechanical Engineering**, vol. 75, 1953, pp. 114-116.
8. "Producing Large-Diameter Pipe to Exacting Specifications,"' W. C. Hoppe; **The Iron Age**, September 25, 1952.
9. "Production Technique and Quality of Flash-Welded Joints," Dr. Hans Kilger, Part II of final report on NDRC Research Project NRC-13.
10. "Investigation of Notch Toughness of Gas Line Pipe Steels," Armour Research Foundation Project No. B566, August 2, 1956.

1958 Annual Meeting of the E.I.C.

21, 22, 23 May. Chateau Frontenac, Quebec City

DISCUSSION

of Technical Papers and Other Articles

WILL ULTIMATE STRENGTH DESIGN OF REINFORCED CONCRETE BEAMS SIMPLIFY STRESS CALCULATIONS?

E. M. Rensaa, M.E.I.C., *The Engineering Journal*, 1957, June, 805

J. G. MacGregor.* S.E.I.C.

Mr. Rensaa's recent paper on ultimate strength design served the very necessary purpose of pointing out some of the major limitations of this method of design. I would like to discuss this paper and its relation to the appropriate sections of the most recent reinforced concrete design codes of the U.S.A.[1] and Britain.[2]

Basically, the question is whether to accept the ultimate strength design method at this time. Mr. Rensaa believes that it may be too early to do this now and he questions several of the assumptions made in deriving the basic design equations. On the other hand, the proponents of ultimate strength design feel that the inaccuracies still remaining in their method are small compared to those introduced by the straight-line theory in use today. In passing, let me quote a distinguished engineer on this subject. "In the field of structural design the effort to get intelligence through standardization has been carried pretty far. In reinforced concrete, for example, it has been necessary to set up elaborate standards. Out of this work came a narrowly circumscribed standardization of procedures which is called the theory of reinforced concrete and to which unfortunate students are exposed. Few will question that the standardized theory of reinforced concrete is perhaps as complicated a bit of nonsense as has been conceived by the human mind . . ."[3]

Balanced Design

Perhaps Mr. Rensaa's chief point in criticizing ultimate strength design is that a "balanced design" beam is undesirable. As he states, such a beam is difficult to construct and is directly affected by accidental differences in concrete strength which might occur in the field. The strength of such a beam is greatly affected by the exact shape of the stress block which will occur in the beam at failure and the failure of this type of beam is sudden and violent, often completely destroying the beam.

While the above are all valid criticisms of any design procedure *allowing balanced or over-reinforced beams,* they are not valid criticisms of the appendix to the A.C.I. Code or to the Load Factor Design Section of the British Standard Code of Practice. The former[4] specifically limits the amount of tension reinforcement allowed in a beam to a percentage which "is about 0.9 of that required to develop the full compressive strength of the section,"[5] and the latter limits the depth of the compression block which can be considered effective.[6] Both these codes, therefore, do not allow balanced or over-reinforced beams.

The Effect of the Shape of the Stress Block

Before the turn of the century, reinforced concrete design formulas were based on ultimate strength concepts. The straight line theory became generally accepted about 1900 since it was mathematically simple and, on the basis of tests available at that time, it appeared to give a reasonable factor of safety. Since that time, as the author stated, many different stress blocks have been proposed. These have been of four general types: rectangular, triangular, trapezoidal and parabolic, all of which were recognized as being approximations to the true shape. The constants involved in defining these stress blocks, however, were derived on the basis of rigorous laboratory experiments. The A.S.C.E.-A.C.I. Ultimate Strength Design Joint Committee Report compares the calculated values of ultimate moment from three of these stress blocks to the actual strengths of seventy-seven singly reinforced test-beams (Table 4 of Appendix A). A similar study was made comparing formula 2 of the committee report (Formula A1 of the A.C.I. Code) and the straight line theory formulas for 299 singly reinforced test beams (Table 1 of Appendix A). The results of these comparisons are tabulated in Table A below.

Table A — A Comparison of Various Methods of Computing Ultimate Strength

Method of Computation	*Test/Calculated Values of Ultimate Moment*			
	Mean	*Standard Deviation*	*Maximum*	*Minimum*
Parabolic Stress Block......	1.09	0.14	1.52	0.81
Trapezoidal Stress Block.....	1.04	0.13	1.39	0.74
Rectangular Stress Block....	1.08	0.14	1.52	0.74
Formula 2 of U.S.D. Report..	1.09	0.14	1.65	0.87
Straight-Line..............	1.30	0.32	2.60	0.92

From the first comparison it can be seen that there is little actual difference between the ultimate moments computed using each of three different stress blocks. The second comparison, however, shows that much more difference exists between the straight-line theory and the more accurate ultimate strength formulas. This latter difference can be attributed to the fundamental differences between the straight-line theory and modern ultimate strength theories.

*Graduate Student and Research Assistant University of Illinois, Urbana, Illinois

Other Applications

Up to now, this discussion has been limited to rectangular beams, conventionally reinforced in tension only. For this type of beam, the final proportions are very little affected by the design method used since the most economical steel percentages are approximately equal to the straight-line theory "balanced" steel percentage. For other types of beams, however, the straight-line theory tends to fall down.

This is true of prestressed concrete beams where the high steel strengths and the lack of a well defined yield point stress make it necessary to use an ultimate strength design procedure to determine the actual factor of safety of a beam. Indeed, much of the recent research regarding the ultimate strength of concrete beams has been done in connection with prestressed concrete.

Similarly, the straight-line theory fails to predict accurately the ultimate strength of beams with compression reinforcing. This was borne out in tests run at the University of Illinois.[7] A straight-line analysis of these beams yielded values for the ratio of test strength to calculated strength ranging from 1.12 to 1.43 and averaging 1.22. For the same beams the A.C.I. ultimate strength analysis yielded a range of 0.96 to 1.08 and an average of 1.03. The reason for this close agreement is that the ultimate strength design methods, as set forth in the building codes previously referred to, closely express the actual behavior of beams with compression reinforcing. The same is also true for T-beams.

Another field where ultimate strength design is superior to the straight-line theory is the design of eccentrically loaded columns. The present design method, for e/t less than 2/3, assumes that the column does not crack until e/t equals 2/3. This approach was first proposed by Prof. Richart[8] who felt that the errors involved in this approximate method were not serious for e/t values less than about 0.5. For columns with greater eccentricities, design is presently based on a straight-line procedure. In Tables 2 and 3 in Appendix A of the A.S.C.E.-A.C.I. report, the actual test results for 184 columns are compared to ultimate loads computed using the 1951 A.C.I. code formulas and the proposed ultimate strength formulas. It should be noted that the empirical nature of the A.C.I. design method makes it impossible to directly compute the maximum capacity of the section. For this reason, the A.C.I. design load is compared directly to the ultimate load and therefore the ratio of strengths includes the safety factor. The mean ratio of test strength to A.C.I. strength (e.g. the mean safety factor) is 3.18, standard deviation is 0.61, with a range of 4.65 to 0.85. The ultimate strength method, on the other hand, attempts to directly predict the ultimate strength and for the A.S.C.E.-A.C.I. Report formulas the mean ratio of test to computed ultimate strength was 0.98, standard deviation 0.094 and range 1.32 to 0.72. To this ultimate strength a safety factor desirable to the designer must be applied.

So far we have discussed only the accuracy and adequacy of the ultimate strength formulas. Equally important to the safety of the finished structure are the load factors applied. While the design equations are based on over half a century of research and thought, the problem of load factors has generally been ignored. It appears that more thought and research into this phase of design is necessary before the Ultimate Strength design method is entirely perfected.

Conclusion

While the writer believes that some parts of the ultimate strength design codes have to be revised in the next few years, it is evident that there are several definite advantages to using ultimate strength design for proportioning flexural members.

References

1. "Building Code Requirements for Reinforced Concrete", (A.C.I. 318-56), American Concrete Institute May 1956. (See also Journal A.C.I., May 1956).
2. British Standard Code of Practice — CP 114 (1957), "The Structural Use of Reinforced Concrete in Buildings", British Standards Institution, London, June 1957.
3. Cross, H., "Engineers and Ivory Towers", 1st Edition, McGraw Hill, 1952, P. 21.
4. Op. Cit. Ref. 1, Section A605 (c).
5. "Report of A.S.C.E.-A.C.I. Joint Committee on Ultimate Strength Design", A.S.C.E. Proc. Paper 809, Oct. 1955. Portions of this paper appeared in: Journal A.C.I., Jan. 1956.
6. Op. Cit., Ref. 2, Section 306.
7. Gaston, J. R., "An Investigation of the Load-Deformation Characteristics of Reinforced Concrete Beams up to the Point of Failure", M. S. Thesis, Civil Engineering Dept., University of Illinois, Urbana.
8. Richart, F. E. and Olson, T. A., "The Resistance of Reinforced Concrete Columns to Eccentric Loads", Journal A.C.I., March-April 1938; Proc. Vol. 34, pp. 401-20. See also University of Illinois Engineering Experiment Station Bulletin No. 368 by same authors.

The Author

The discussion by Mr. J. G. McGregor Jr., E.I.C., is of interest because it represents the general opinion of those who have been converted to believe in the efficacy of the ultimate load design method. His final conclusion, however, contains the statement of belief that "some parts of the ultimate strength design codes have to be revised in the next few years". The author certainly agrees with that opinion.

Mr. McGregor quotes a statement made by Hardy Cross to the effect that the usual theory of reinforced concrete is more or less nonsense. It is unfortunate that an engineer of the standing of Hardy Cross should make such a rash and unfounded remark. Such a statement is apt to mislead students and young engineers into believing that the present theory of reinforced concrete, which has been built up by a large number of able men, ought to be scrapped. As far as standardization is concerned, the greatest attempt in that direction is really the ultimate strength design method which its proponents are trying to make universally applicable. Reinforced concrete happens to be a composite material which needs special treatment of different parts and functions of structural elements. A thorough knowledge of basic facts is therefore necessary even if this involves elaborations. It is unfortunate that the attempt to simplify has in time led American text book writers to cut out basic explanations to a very large extent. The result has been a too literal belief in approximate formulae. When it was then found that these had limited applicability, some engineers reached the conclusion that the whole theory was wrong and should be abandoned.

I think it is incorrect to say that "before the turn of the century, reinforced concrete design formulas were based on ultimate strength concepts". This is hardly true if meant to indicate the use of a stress distribution different from the straight line one. There was no mathematical reinforced concrete theory before the work of Koenen was published in 1886 and his was of the straight line triangular type. Other engineers who during the next fourteen years until the turn of the century continued the development of the mathematical theory also based their work on straight line stress distribution. It is true that they found very early that this did not give a correct picture of concrete stresses at ultimate loads, but the present concept of ultimate stress design never made any headway. The reason for this was the necessity in most cases to calculate the stresses for conditions of use. The author does not think that this reason has been made obsolete by any later developments.

It is correct that for tied reinforced concrete columns, the ultimate strength design is the best. This is not the case, however, for spirally reinforced concrete columns. It is possible to design such a column so that it will be shortened by loading as much as 3%. This would mean that a column 100 in. high could be compressed 3 in. The shell would have cracked long before this and the column and supported structure would certainly be in a precarious condition. We should in this case again have been forced to limit our load on basis of conditions of use instead of on ultimate load capacity.

The author had purposely limited the scope of his paper to the discussion of ordinary beams. Discussion of columns would require a rather long paper.

SHEAR, DIAGONAL TENSION AND BOND STRESSES IN REINFORCED CONCRETE BEAMS

E. M. Rensaa, M.E.I.C., *The Engineering Journal,* 1957, October, p. 1464.

I. F. Morrison*

Under the heading, Shear at Points of Contraflexure, on page 1467, the author states, "The ordinary formula for shear in a reinforced concrete beam $v = \frac{V}{bjd}$ is based on the assumption that the concrete below the neutral axis is unable to take tension . . .". And further on, "The term jd, therefore, has no definite value . . ." The writer does not agree with these statements.

If one goes back to the derivation of the usual formula, it will be found that, regardless of the shape of the stress-solid assumed for the compression area and for the tension area of the cross-section of the beam, there will always be some distance from the neutral axis to the centroid of that portion of the stress-solid above an assumed horizontal section on which the longitudinal shearing stress is to be computed. As different horizontal sections are selected, the longitudinal stress varies from zero at the top of the beam to some maximum value and then decreases to zero at the bottom. The value of jd, when placed in the usual formula, gives this maximum value of v. It is the distance from the tension reinforcement to the centroid of the stress solid above the section of maximum shearing stress.

The value of V represents the $\frac{dM}{dx}$ i.e. the rate of change of bending moment along the axis of the beam. So that, although the moment is zero at a point of inflexion, this fact does not enter into the derivation of the usual formula for the maximum longitudinal shearing stress.

*Professor Emeritus of Applied Mechanics, University of Alberta, Edmonton.

It will be recalled that shearing stresses are always in pairs at right angles to each other and, therefore, the vertical shearing stress is equal in value to the longitudinal. There is always a neutral axis, although it may not lie within the cross-section.

In respect of a cracked section assuming the crack to be vertical, there can be of course no vertical or longitudinal stress at the end of the crack. But above this point there will be a shearing stress which varies in value to a maximum at some point and then decreases to zero at the top of the beam. Where the computed maximum value will occur would depend on the shape of the stress solid-assumed. Under any circumstances, however, there will be a definite factor such as jd in the formula which will yield the maximum value of v.

In this case, there will be also a compressive stress where the value of v becomes a maximum and since it is the tension stress on the concrete, which arises from the shearing stresses, which is important, the Mohr's circle should be plotted to determine the value of it. If it be excessive, then suitable reinforcement should be provided. Incidentally, this same point arises in the theory of prestressed concrete beams which benefit considerably in reduction of the tension stress on the concrete due to the combination of the shearing stresses with the compressive stresses in the concrete caused by the prestressing.

In the last paragraph on page 1467, the author claims that it is necessary to use the formula for homogeneous sections in order to find the actual shearing stresses. If this means the formula for unreinforced rectangular sections, then it is not correct for concrete sections reinforced top and bottom. The transformed section should be used. It will be noted that the formula for the unreinforced section can be written $v = \frac{V}{b\ .67d}$, so that here in effect the definite value of j is 0.67. For the transformed section, j will have a different and larger value. The shear stress distribution curve is, of course, parabolic between the reinforcements. At the reinforcement, a discontinuity occurs and part of the shear is transposed into bond stress along the reinforcement. The curve then goes to zero at the free surfaces of the beam.

The Author

The author's statement in his paper that the usual shearing stress formula for reinforced concrete does not apply at points of contraflexure seems to be difficult to accept by some engineers. It is, therefore, of value that this statement has been questioned by Professor Morrison because it gives an opportunity to explain this fact in more detail and to show that it is correct.

When calculating the stresses in a reinforced concrete section, it is usual to designate the condition before there is any cracking as "Case 1". When a crack forms and only a part of the concrete section is effective, the condition is designated as "Case II". The usual shearing stress formula for reinforced concrete with its corresponding stress diagram is based on the conditions of Case II. This assumes cracks to be perpendicular to the axis of the member and that there will be an uncracked portion from the neutral axis to the compression side of the beam.

In order to follow the action of the stressing of the member, it is necessary to start with Case 1. We know that concrete has its greatest weakness in tension and when it cracks it will be along a line perpendicular to the principal tensile stresses. This cracking line is never vertical at a point of a beam acted on by transverse forces in a location where there is little or no bending moment. The assumption of vertical cracking at such a point to suit our usual shear stress formula is therefore not in order. Furthermore, since the tensile stresses perpendicular to a diagonal line will extend from top to bottom of the beam and will be of greatest magnitude near midheight, we cannot generally figure on the crack stopping before it has passed through the complete section. From the above two considerations, it should be clear that the assumptions of Case II do not hold at points of contraflexure. In fact, there is no Case II in the accepted sense of the term but only Case 1 and a second condition with complete cracking where the reinforcing steel must carry the full shear. Unless this fact is understood, the most important point in the paper has been missed. The use of a formula with its stress diagram in a place where it does not apply is, therefore, quite misleading. Although it is hardly necessary to write any more about this case it might be worth showing how ridiculous a condition it might lead to if we accepted the formula for general use. Assume a section just to the left of the point of contraflexure with negative moment. There should then be a vertical crack from the top of beam to the neutral axis. On the right side of the point of contraflexure with positive bending moment the crack would be from the bottom of beam to the neutral axis. Assuming the formula to hold from both sides to the point of contraflexure the two sections could be moved infinitely close together with the result that there was a vertical crack clear through the beam. This would certainly be an easy way of explaining the weakness at a point of contraflexure but it would have nothing in common with facts.

That the usual shear formula does not give correct values of maximum shearing stresses where there is little bending is not a new discovery. A two page discussion about this matter (not especially referring to points of contraflexure) may be found on pages 340 - 341 (Wirkliche Schubspannungen) in the book by Rudolf Saliger[1].

Regarding the use of the fundamental shearing stress formula for the uncracked condition, Case 1, the author is quite aware that the transformed section should be used if the object is to calculate the exact shear stress distribution. That the steel will have some modifying effect has also been mentioned in the article. This effect will be to cut "notches" into the upper and lower limits of the diagram about similar to those for a flanged beam. The knowledge of the exact stress distribution along an inclined section would, of course, have some academic value. However, this is rather unimportant for the main purpose of the paper. The important fact is that the sum of vertical shearing stresses at a section must be equal to the external shear and that the shearing stress is greatest at about the middle height of beam and decreases in some kind of order to zero at both top and bottom of beam.

If we want to give a designation of the internal lever arm, some other term than jd should be used because this designation assumes the lever arm to be measured from the reinforcing steel. Such an assumption is generally not in accordance with the starting or terminal points for the internal lever arm in an uncracked section. Anyhow, the cause of failure at a point of contraflexure is not caused by internal shearing stresses but is rather due to diagonal tension where the central portion of beams is "hung onto" the cantilevered beam end. There is considerable similarity between this case and the case of a reinforced concrete member subject to direct tension. Before cracking, concrete carries most of the tensile force, while the steel must take the complete tension after the concrete has cracked. It is in reality a mistake to think that concrete can take no tension. If that was the case concrete would be completely useless as a construction material. The stability of continuous slabs for instance, is secured by the diagonal tension in most cases being so low that it can be safely carried by the concrete.

The author would like to draw the attention to a printing error in the equation on page 1469 second column where the sign after T should be an equal sign instead of a minus sign. It would also have been better instead of Q to use R or V to represent the shear at the section.

There is a statement in the paper which needs some qualification. This refers to the third column on page 1465 where it is mentioned that where shear has any influence on ultimate strength this increases until web reinforcement sufficient to carry the complete shear is provided (Reference 4). Later information (2) has shown that this statement based on the work by Mörsch only applies for concrete of comparatively low strength as was generally used in the first quarter of this century. Even Mörsch found that when concrete had reached a cube strength of 225 kg. per square centimeter (approximately 2500 p.s.i. cylinder strength) web reinforcing for half the shear would give as much ultimate strength as full web reinforcing. It is rather seldom at the present time that reinforced concrete of less than 2500 p.s.i. strength is used in North America even though this is not the general case in Europe. To reinforce for the full shear, excepting where it reaches a very high intensity, seems therefore unnecessary. This statement does not apply to the vicinity of points of contraflexure where full shear reinforcing should be provided if there is any danger of failure in diagonal tension.

It is not too difficult to understand why stronger concrete will need less web reinforcing for bending-shear conditions than weak concrete would. Not only will the strength in combined compression and shear on the remaining uncracked portion be greater but the web steel will be much more effective due to a more secure anchorage in better concrete. Where bent up bars are used, the higher compressive strength at points of bends will provide more resistance to crushing, making such truss bars more effective. The author had these conditions in mind when making recommendations to the National Building Code committee. It was recommended and later tentatively adopted that only two thirds of the shear at bent sections needs to be carried by web reinforcing. This is less than provided by European practice but more than generally specified by the A.C.I. Code.

The question may properly be asked if it is necessary in all cases to provide web reinforcing at points of contraflexure. The author does not think that this is the case. We know that concrete can take some tension and that also applies when this acts in a diagonal direction. Continuous reinforced concrete slabs, for instance, have given little or no trouble at points of contraflexure because the diagonal tension in most cases will be low and on the safe side. It is clear, however, that the allowable diagonal tension should be lower at a point of contraflexure than near the face of an internal support where there is both shear and bending. It is fortunate that in most cases the shear at points of contraflexure in a uniformly loaded member complies with such a requirement. In practice it may vary somewhere between 50 and 70 per cent of the shear at the face of support. For a member of uniform cross section this automatically provides a corresponding reduction in diagonal tension. This may not be true for concentrated loading and for non uniform cross sections. The author thinks that if the maximum allowable shearing stress at face of an internal support does not exceed what is allowable for unreinforced concrete then no special web reinforcing at points of contraflexure is needed unless conditions are such that the shearing stress at this point exceeds two thirds of the allowable shearing stress. If, however, the allowable shearing stress at face of support is exceeded, web reinforcing for at least two thirds of the shear at support and for the full shear at and somewhat beyond the extreme location of points of contraflexure should be provided. This simple rule will exclude, in the majority of cases, slabs and stubby beams from the strengthened code provisions for shear. Special precautions should, however, be taken when the continuous line of beams is long or restrained from longitudinal movement and where most of the load is of a permanent nature.

While it may not be theoretically necessary with low shearing stresses to provide web reinforcing in beams, the author thinks that stirrups should be placed along the complete length of beam in any case. This should be mandatory where the beam is rectangular. Stirrups, in addition to giving more secure placing of steel, are also useful to provide resistance against splitting and as ties where the reinforcing is in compression.

A MAJOR POWER PLAN FOR YUKON RIVER WATERS IN THE CANADIAN NORTHWEST

J. M. Wardle, M.E.I.C., *The Engineering Journal*, 1957, November, p. 1638

C. C. Marshall,* M.E.I.C.

The author is to be congratulated on an admirable presentation of a most interesting project.

The general public, and perhaps many engineers, do not appreciate the tremendous amount of work that must go into the early stages of a scheme of this nature and magnitude, and how easy it is to spend a great deal of time and energy exploring blind alleys.

I have had the privilege of visiting the areas in question during the survey and of advising the author on certain aspects. I was most impressed by the way the work had been organized and carried out.

The project represents one of the few remaining great blocks of cheap power on the North American continent.

It has the great merit that it can be developed in stages. Its principal disadvantage lies in the location of the industrial area on the Taku River just within the United States border, which precludes the construction of a deepwater port in Canadian territory.

However, I am disposed to think that, in the long run, this disadvantage may prove to be a blessing in disguise. Mr. Wardle has mentioned the possibility of transmitting power to Alice Arm, where deepwater sites would be available in Canadian territory. I would like to look even further to the Lower Nass Valley from Aiyansh to the sea. Unlike so much of British Columbian territory on the coastal belt, this region is relatively flat and open and affords many square miles of area suitable for towns and industry. The imbalance of the distribution of population in B.C. is well known, and was indeed a subject discussed in the Province's recent brief presented to the Gordon Commission.

It is my view that, in the years to come, part of the solution will be in the development of the Nass Valley into a great industrial area. A certain amount of power is available locally on the Nass River itself. The question of whether it will be found best to develop this power first, or to go for the first stage of the scheme described, with an industrial area on the Taku, is one to which the answer will be worked out during the next year or two.

My point is, however, that in taking the longer view, the presence of this great block of power only 360 miles to the north of Aiyansh cannot but have a profound effect on the pattern of the Province's development.

*Chief Representative and Chief Engineer in Canada, Sir Alexander Gibb and Partners, Toronto.

Discussion from Meeting of the Institution of Civil Engineers

This paper was also presented to The Institution of Civil Engineers and was published in the Institution's *Proceedings* (vol. 7, pp. 441 - 464, July 1957) together with considerable discussion, to which the author replied.

Readers who are interested in this additional discussion should refer to the Proc. Instn. Civ. Engrs., as above, or get in touch with the library of The Engineering Institute of Canada at headquarters in Montreal.

FORCES INVOLVED IN PULPWOOD HOLDING GROUNDS

R. J. Kennedy, M.E.I.C.

The Engineering Journal, 1958, Jan., 58

G. E. LaMothe, M.E.I.C.†

As Professor Kennedy states, this is a very important subject to the pulp and paper industry; millions of dollars are tied up in structures which are often under heavy strain, the design of which up to this day has been, to say the least, haphazard.

As the author clearly shows, this is a hydraulic problem and a very abstract one at that; as he states, no single measurement will describe the condition of a boom layout.

So far, Prof. Kennedy's laboratory and field experiments have conclusively covered holding grounds where the average or surface velocities are relatively low. Under these conditions, the question of design arises.

For instance, it is to be noted that the Manicouagan site "check" (Appendix II) goes to show that the piers carry a relatively small proportion of the load in this case of low velocities. One may ask oneself this question: Were all these piers necessary, and could the load have been carried by guys anchored to the bottom, instead of piers, at a considerable saving? In other words, what conditions are required to oblige one to build piers?

This is not intended as a criticism of the Manicouagan boom layout, which was designed for absolute safety and before the mass of the information gathered by Prof. Kennedy and his associates had crystallized, but is meant to show the ramifications of the problems involved.

Many holding grounds in this country have been located where the water velocities are high (much higher than at Manicouagan) so as to fit into the mill location or for other imperative reasons.

As the industry expands or new rivers are opened, such locations will have to be used to hold wood. For instance, some present-day locations have after the jam is formed a considerable ΔH, according to the author's nomenclature.

†Chief Engineer—Woodlands, Price Brothers and Company Limited, Quebec, Que.

In one case I can recall, the ΔH was about 12 feet with an L of about ¼ mile; the SL being perhaps one foot or so, if no wood or piers had been there. This caused very heavy log jam, in some places over 15 feet thick, resting on a nest of piers which, in turn, held heavy booms tied together with chain. In this case, the piers carried the load, the boom's load being relatively insignificant after the jam was formed.

To date, these layouts have been designed by "hit or miss."

In summary, there are two types of boom layouts: one where the velocities are not too great, and the load is carried in great part by the booms - this is covered in Prof. Kennedy's paper; the other, where the velocities are so high that the load must be carried by the piers completely, or by both booms and piers.

Prof. Kennedy and his team know of this, and it is my belief that, with the information gathered to date and further laboratory and field tests, better methods than used today will be found, perhaps by exploiting more than it is today the division of force between the boom and shore, as illustrated in Figure 18 of the paper.

In concluding, one may well remember that the development of the basic hydraulic formula $V = \sqrt{2gh}$ has taken a long time to come to its present-day state, with a lot of dispute; the whole matter being of course empirical.

It is hardly a century since Francis came out with this weir formula, based on a spillway a few feet long and not two feet deep. As water demands grew, the application of this formula was extended by experiments to what it is today.

I feel that the present problem in Prof. Kennedy's able hands is of the same type, coming from the great expansion of Canada's number-one industry.

WINTER CONSTRUCTION

C. R. Crocker, M.E.I.C. *The Engineering Journal*, 1958, February, p. 43.

F. G. Rutley*, M.E.I.C.

I must agree with the author that the consulting engineer and the architect can reduce costs on winter construction if they and their clients will only watch the timing when a construction job is started. It is not economical to start a construction job in the middle of winter when everything is frozen up. Winter costs are naturally higher but they can be materially decreased with proper timing. If construction can be started in the early fall so that the contractor can get out of the ground before the really cold weather, then the contractor can handle his contract in a reasonable manner. Latterly, wage increases have come into effect in the spring and most workmen are definitely more work-conscious in the winter when there are construction men out of work. Consequently, labour costs are generally reasonable. Most of the increased cost of winter construction is due to heating, protection against the elements and the increased materials that are used up in protection and heating units and fuel.

There is another way the consulting engineer and the architect can help to decrease costs. There are more or less standard specifications on how to carry out most construction work during winter. Naturally these specifications are written for the most exacting conditions. There are many times and many occasions where the maximum winter protection is not necessary. In many cases the good judgment of the professional designer is lacking and in its stead is left an inspector who may or may not have the qualifications to judge when maximum or minimum winter protection is necessary.

*President, The Foundation Company of Canada Limited, Montreal.

AUTOMATIC COMPUTING FOR PROCESS-UNIT OPERATING GUIDES

H. F. Moore *The Engineering Journal*, 1958, February, p. 57.

K. N. Thompson†

Successful computation of guides for operating oil processing units will be a major forward step in simplifying the application of human judgment to process control. Significant gains in economy of operation should follow.

Mr. Moore emphasizes that simple, reliable data gathering and computing equipment is required. At an instrumentation session sponsored by the American Petroleum Institute's division of refining in Philadelphia May 15th, a panel discussion brought out that performance of the existing data loggers has been poor by any standards. Further study indicates that both design and maintenance failures have contributed. The possibilities of process parameter computation emphasize the need for correcting this condition. Equipment manufacturers have underrated the need for reliability, stability and longevity of components. Equipment designs must have more provisions for testing components while the equipment is operating. Both suppliers and users have underestimated the skill and training needed to adequately maintain logging and computing systems.

There is a current trend toward contracting for maintenance of data handling equipment in the same manner that business computer maintenance is handled by the manufacturer, or by a service corporation. This ties in with the "systems approach" to engineering, design, procurement, installation and maintenance of complete instrumentation and data handling facilities for process units or refineries. There are many advantages inherent in this approach. There is also a potentially serious disadvantage.

Major oil companies design their own processing facilities. As these designs become more costly and complex, the adequacy of control, especially dynamic control, becomes much more vital to successful operation. The process design groups must include people thoroughly familiar with the actual "in service" capabilities of measuring, control and computing components. Organizations which purchase instrumentation and data handling design, installation and maintenance assistance may seriously increase their problem in obtaining trained competent people for process control engineering, since they will be unable to provide detailed instrument engineering or service experience. This must be weighed against the current difficulty in obtaining skilled instrument service people through refinery labor training methods.

†Socony Mobil Oil Company, Inc., New York.

DISCUSSION

The editor invites discussion of papers appearing in the *Journal*.

Readers may contribute to this section by sending appropriate comments to the *Journal* office.

ABSTRACTS

BASED ON CURRENT LITERATURE AND EVENTS

CANADIAN AVIATION INDUSTRY REVIEW

E. Hamphill, *Canadian Aviation*, v. 30 n. 12, Dec. 1957

Looking back on a course charted long before the 12 months under review, the Canadian aviation industry may well designate 1957 as a banner year. Here are the highlights.

December, 1956: The West German Republic places an order for 225 Canadair Sabre VI's, a contract representing an investment of 80 million dollars, including 400 Orenda 14 turbojet engines and spares.

January, 1957: Trans-Canada Air Lines reports its first 2 million passenger year and outlines plans for re-equipment which will make it one of the first all-turbine airlines in the world by late 1960.

February: Exactly on schedule Canadair rolls out its first CP-107 Maritime Reconnaissance version of the Bristol Britannia, the largest aircraft ever produced in Canada.

March: de Havilland Aircraft of Canada reveals details on its new twin-engined utility transport and announces that the United States Army has obtained special permission from the American Defense Department to place an evaluation order for five Caribous, off-the-drawing-board.

April: Canadair concludes extensive licensing agreements with Bristol Aircraft Ltd. of England for production and sale of Canadair modified commercial versions of the Britannia to be powered by Bristol Orion turboprop engines.

May: Canadian Pacific Air Lines inaugurates service on its precedent-setting new route to Europe linking Mexico and South America with the Iberian Peninsula through Toronto and Montreal.

June: Belgium places a 50 million dollar order for 54 Avro CF-100 Mark V's to be supplied under NATO mutual aid commitments financed by Canada and the United States.

July: Orenda Engines Ltd. unveils its Iroquois turbojet, rated by independent observers throughout the Western world as the most powerful jet engine at its stage of development.

August: Nordair Ltd., a new carrier combining the assets of Mont Laurier Aviation Ltd. and Boreal Airways, inaugurates a new service between Roberval and Frobisher Bay, establishing the first regularly scheduled air service between the Eastern Arctic and a southern base.

September: The Royal Canadian Air Force officially accepts its first CP-107 Argus from Canadair Ltd.

October: Avro Aircraft rolls out its first CF-105 Arrow all-weather supersonic interceptor, described as the ultimate in manned fighter aircraft.

November: Canadair Ltd. announces its decision to proceed with production of two prototypes of its original design for an ab initio jet basic trainer, the CL-41. Orenda Engines Ltd. reveals that the Iroquois has been run in flight in its modified B-47 test bed with completely satisfactory results.

December, 1957: Avro's Arrow will make its first flight powered by Pratt and Whitney J-75 engines.

Viewed strictly as dollars and cents and revenue miles the industry respectively maintained and surpassed records of previous years. Manufacturers' records for the year 1956 indicate sales totalling about 356 million dollars, about the same as in the previous year. During 1956 the manufacturing industry paid a record 114 million dollars in salaries and wages. For 1957, figures available at press time cover only the first six months of the year. They indicate that employment over-all will be up some 10 per cent over 1956 totals. Predicted on 1957 Canadian defence expenditures on a par with 1956 (about 240 million dollars), this year's unprecedented success in the export field should push 1957 sales above previous totals.

ALUMINUM WELDING EASY WITH LOW TEMPERATURE FLUXLESS SOLDER

S. Freedman, *Canadian Electronics Engineering*, v. 1 n. 8, Dec. 1957.

Aluminum is a metal difficult to solder or weld because it is covered by a protective oxide film which forms whenever it is exposed to air. This film will not disintegrate at temperatures less than the melting point of aluminum itself (1218 deg. F.). Unless this film can be penetrated, soldering (adhesion) or welding (fusion) is impossible.

Various blends of fluxless aluminum solder or welding rod have been developed which require application temperatures between 500 and 800 deg. F. On a research basis work is continuing to enable dropping the minimum temperature 100 to 150 degrees so that soldering irons can be used. The successful blends have been those which were high in zinc and contained up to several per cent of lead. However, zinc and lead are normally unblendable because the lead sinks to the bottom and separates the grains of zinc and makes a powder. Blending, homogenizing and cleansing the ingredient metals were necessary. This was accomplished by adding a small quantity of muriatic acid with the metals in a molten state. In order to prevent any risk of explosion, a special super-porous flour-like material with many pores per grain was developed. It was impregnated with muriatic acid to a paste consistency and introduced into the molten metal by special techniques. What would otherwise become a single instantaneous explosion is safely converted in a prolonged boiling and agitation of the molten metal, and its intensity is fully controllable. The object is to cause optimum homogenization of zinc and lead and other metals, and to lift up non-ferrous residues and impurities to the surface.

While ordinary soft solder will not adhere to aluminum, if the aluminum is first tinned with this special fluxless solder (Chemalloy) soft solder will readily adhere to it. This permits the attachment of any metal that can itself be soft-soldered. Chemalloy solder requires only 40 per cent of the aluminum damage temperature for joining and so this protects the parent metal during the heat-up process. Also the solder has an electrically balanced property which reduces corrosion and gives it dry bearing abilities to withstand friction without coolant or lubrication. It has never splattered or exploded and has shown no hazard in use as verified by thousands of trials and tests.

The techniques by which this joining material is derived can undoubtedly be used to improve other metals or metal blends so as to yield special properties. The bearing properties of Chemalloy by which it functions without lubrication and without generation of heat for appreciable periods of time seem to be due to microscopic space-separated electrical friction rather than direct full metallic contact. The bi-polar electrical properties, dry bearing properties and ability to penetrate surface oxides without flux appear to be inter-related. It holds high promise as a substitute for tin in babbit metal applications. With an increasing market the eventual price is expected to be very close to that of bulk aluminum.

UNDERGROUND GASIFICATION OF COAL

Engineering, v. 184 n. 4788, Dec. 13, 1957.

The possibility of gasifying coal was suggested in 1868 but no large-scale experiments were made until 1931, when field work, which has continued ever since, was started in Russia. In Great Britain, experiments began in 1949 and they are still in progress.

Underground gasification offers the double advantage of supplementing the power supply and of using coal seams which, because of low grade, faulting, thinness, or some other natural feature, would not be economic to work by orthodox mining methods. No solid matter is brought to the surface while the coal is being gasified and the only interference with agriculture or amenities is that caused by the shafts and pipelines all of which are small and of a temporary nature. Subsidence is relatively small. The gas produced is of low calorific value (usually less than 100 B.T.U. per cu. ft.) but it is combustible, and an obvious way to use it is in electric power generation by orthodox steam plant. It is on these lines that the present experiments are proceeding.

For some years the main experimental work was based on working from the surface, and some success was achieved with the two principal methods tried, high-pressure linkage and electro-linkage, both of which opened up passages for air and gas in the coal seam between vertical bore-holes. Linkages up to 50 yards were obtained, and on one occasion 800 tons of coal were gasified in a single trial. It was decided, however, that neither method was sufficiently reliable for commercial operation, and in 1953 the experiments were changed from the purely surface-operated kind to a type in which a certain amount of preparatory work is done by men working underground. This enabled boreholes to be put into the coal from galleries driven in the seam, and so provide a more positive means of controlling the flow of air and gas.

Given the necessary underground access to the seam, boreholes can be used in two different ways. They can be put through from one galley to another, to enable the air for combustion to go in at one end and the gas to be taken out at the other. Alternatively, they can be driven to a blind end, with no outside connection, and, the coal having been ignited at that end, air can be passed in through a core tube, and the gas drawn off in the space between the air tube and the borehole wall. Hot gases passing back along the borehole transfer much of their sensible heat to the ingoing air. It is this technique which is being used today.

Responsibility for underground gasification was taken over from the Ministry by the National Coal Board in 1956 and a 73 acre test area is located at Newman Spinney. In co-operation with the Central Electricity Authority work is now in hand for a pilot system to produce gas in sufficient quantity to generate 5 MW continuously for several years, beginning next year. This installation, about one-tenth of the size of the smallest commercial scheme, will enable further data to be accumulated for the design of a full-scale scheme. In particular, it will provide a basis for determining costs and will give technical information on plant operation.

The practicability of the blind borehole technique has been established beyond doubt, but much experimental work requires to be done to clear up various technical problems. In its essentials the blind borehole method is simple. When the borehole has been drilled to the required length an air pipe is inserted in it, together with a small pipe carrying at the inbye end an electrically-ignited firework of the flare type in a waterproof container. The ignition of the coal is by means of this firework and propane or other gas fed up the small tube for a sufficient length of time to enable the coal reaction to become established. Possible dimensions for the borehole are: length 300 ft.; diameter 12 in. air pipe dia. 4 in. Mild steel tube has been used for the air supply, but experiments are in progress with high-chromium cast-iron tube, sleeved at the forward end with refractory material to protect it against excessive temperature and corrosion. For obtaining experimental data in a single borehole trial, instruments are provided on the surface for recording temperature, calorific value, gas constituents (including moisture), specific gravity, air and gas flow, and pressure and water level in the sump.

The pilot system, on which work is now in progress, is scheduled to be producing gas by December 1958. It will consist of a number of sections or "arrays" each having an 8 ft. diameter shaft and a gallery 100 yards long, with ten boreholes 100 yards long drilled on each side from bags spaced at 10 yard intervals. Each section will thus cover an area of about 20,000 square yards of coal seam. Two arrays operated simultaneously will provide the desired gas output of about 1 million cu. ft. per hour, and at this rate of production they will have a working life of about six months. Fresh arrays will be brought into production as the original ones become exhausted. Air will be taken from a central blower house via mains up to 36 in. in diameter to the shaft tops at a maximum pressure of 10 psi and thence by ducting and manifold to the borehole air tubes. Gas mains up to 48 in. in diameter will take the gas to the power station, and a booster in the gas line will maintain a negative pressure in the galleries. Gas and air may be pre-heated with chimney heat at the power station.

UNDERWATER OIL TANKERS?

Engineering, v. 184 n. 4788, December 13, 1957.

A current research investigation sponsored by Mitchell Engineering Limited, Great Britain, if it proves fruitful, may lead to a revolutionary advance in the design of oil tankers. The possibilities of nuclear propulsion units for underwater craft have revived interest in the potentialities of high-speed submarine oil tanks and experiments are now being carried out on underwater hull forms.

It has been announced some months ago that the Japanese are well away with the design of a nuclear powered submarine tanker, but with a dead-weight of 30,000 tons and a submerged speed of 22 knots it would appear to be quite a conservative venture in comparison with the British proposal. The concept is that, given a propulsion unit independent of air supplies and capable of developing very high powers, a small fleet of large high-speed underwater tankers, with a high ratio of payload to deadweight, might well be competitive in cost with the slower conventional surface tanker. The magnitudes envisaged are of the order of 100,000 tons total weight, cruising at speed of 50 to 60 knots. By operating at depths far below the surface, wave-making resistance, which constitutes the larger part of the drag of a surface vessel can be drastically reduced, and by suitable hydro-dynamic design of the body, at high speeds an overall resistance very much lower than that of a conventional vessel can be obtained.

Eight models are being tested in a towing tank and the model data will be extrapolated to full-scale Reynolds number to provide data for a range of sizes of full-scale bodies so that the effect of size on hydrodynamic efficiency and operating economics can be assessed. A rough determination of the effect of the body shape on propeller efficiency, and hence the best combination of propeller design and hull form is also to be made for the full-scale craft. Possible alternatives for the prime mover include steam turbines supplied from a heat exchanger through which the reactor coolant flows; or possibly, the reactor may be gas-cooled and the coolant gas used directly in a closed-circuit gas-turbine; or electrical energy may be derived directly from the nuclear plant. The propellers operating at high speeds in the fully cavitating region are therefore likely to be of the narrow-blade wedge-section "supercavitation" type, giving much lower friction loss at such speeds than propellers of conventional design. Although maximum efficiency is likely to be attained by the usual pusher-type propeller this has the disadvantage of imposing compressive stresses on the shell which are undersirable due to the possibility of using a very light structure. Apart from a small space for the crew and space for the reactor block the whole vessel will comprise a liquid container. Although hydrostatic pressure at the operating depth may be ten atmospheres or more, the shaft structure would serve, in practice, only as a surface of separation of two liquids, and would be very lightly stressed. In the absence of waves there would be no back-breaking bending moments such as a surface vessel has to cater for, and the propeller loads would probably be arranged to act in tension. Tractor propellers at the nose or padded pusher propellers amid-ships are possible alternatives. Unloading of the oil cargo would be carried out underwater, taking in water as the oil was pumped out through flexible pipelines.

A yet more radical solution to the propulsion system might be to use the heat of the nuclear reaction to energise a propulsive water jet. This is not very efficient but possibly much simpler to instal than a turbine and shaft drive, and if ample power is available the low efficiency may be a small matter in comparison with mechanical complication.

It seems likely that auto-stabilization of the vessel both in roll and in pitch would be desirable, probably controlled by means of hydrovanes. Only a very small crew would be required, and, because air-conditioned living space would be severely restricted, both for structural and for air supply reasons, they would require to be specially selected and trained to withstand the psychological strain of confined living.

STRESSES ALTER HARDNESS

S. K. Setty, J. T. Lapsley and E. G. Thomsen, *Mechanical Engineering*, v. 79 n. 12, Dec. 1957.

Since hardness measurements have come into wide-spread use for production control and for predicting mechanical properties of heat-treated steels, it is important to understand errors that may be introduced by residual stresses or by stresses due to external loading. The present investigation set out to determine hardness under uniform stress as well as bending (gradient) stress, and during states of stress below and at the intantaneous yield condition of the metal.

Penetration hardness tests of the Brinell and Rockwell type give hardness numbers in terms of resistance to local plastic penetration into the test piece, by a ball or cone, at constant load. The hardness numbers therefore, must be related to that state of stress induced in the test piece under the indentor which will be just sufficient to prevent continued penetration. Hence this region of metal must be at or near the instantaneous yield condition, and any simultaneously superimposed stresses could have the effect of either increasing or retarding yielding at this point. Determination of the state of stress under the indentor which will fulfil the yield condition should reveal whether or not superimposed stresses will influence the hardness readings.

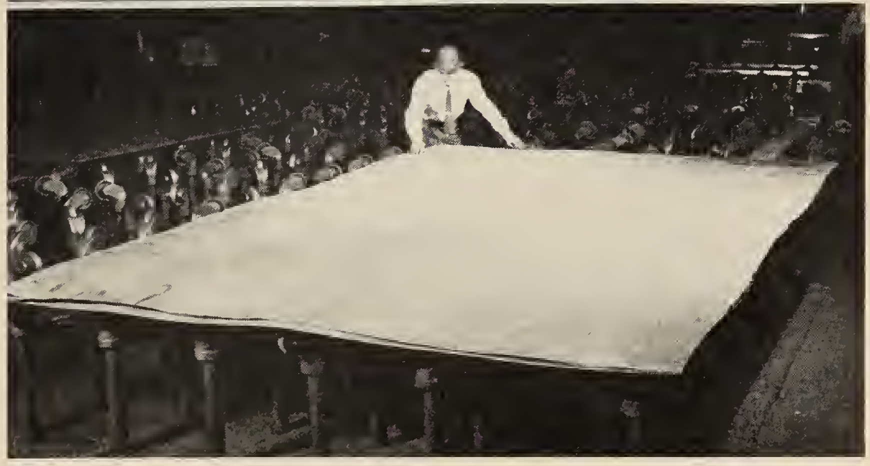
An examination of mathematical equations describing the yield condition in terms of the elastic state of stress and of maximum shear for a sphere penetrating a flat surface indicates that under constant load the final hardness must be decreased when tension stresses are present, and conversely an increase would result if compressive stresses are present. Thus materials appear to become softer under tension and harder under compression.

A series of experimental tests were carried out. Mild steel (SAE 1020) specimens were annealed and carefully machined to retain flatness and minimize machining stresses. The specimens were then loaded uniformly in a portable test fixture in axial tension and subjected to hardness measurements. It was observed that as the tensile stress increases the hardness decreases approximately linearly in the elastic region. It departs from linearity as the yield strength of the material is approached.

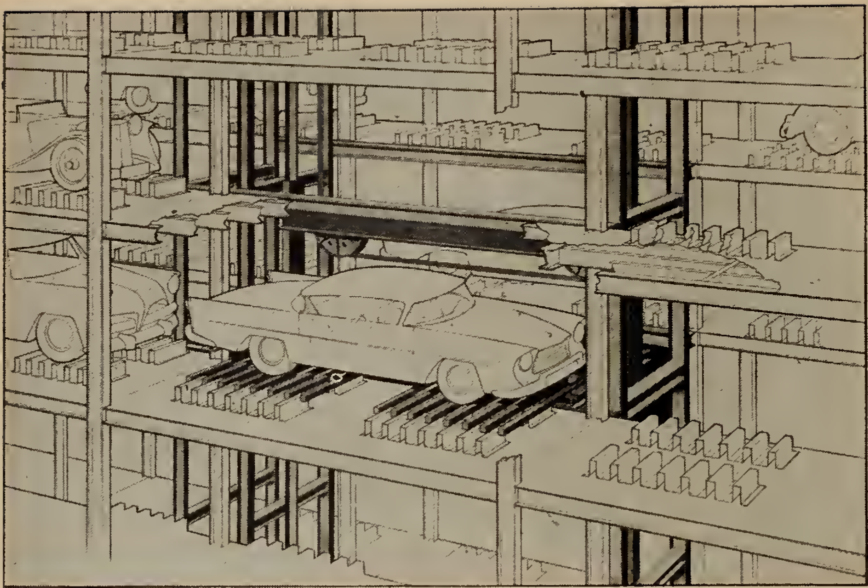
In order to test if an increase of hardness is obtained when a test specimen is under compressive loading, 2 in. dia. annealed commercially pure aluminum (1100-0) was subjected to combined compressive loading. This was accomplished by subjecting the specimen contained in a steel jacket to an axial load of approximately 80,000 p.s.i. and then releasing the axial load before making hardness tests. In this way the springback of the retaining cylinder induces biaxial compression in the test bar. The increase in hardness was relatively small indicating that compressive stresses are less effective in altering the hardness of a material than are tensile stresses.

Another series of hardness tests was run on tensile and compressive stresses induced in a bent mild steel strip. These strips were machined and then bent plastically to various radii. They were then annealed in the deformed state and descaled by an acid dip. The specimens were then mounted in a bending fixture in which bending moments could be applied until the specimens were again straight. Hardness readings were taken on both sides of the specimens. The object was to evaluate hardness changes in the presence of stress gradients but without subjecting the test section to curvature while under load. Results indicate that the decrease in hardness on the tension side is generally larger than the increase on the compression side. Also, comparison with the first tensile tests shows that the decrease in hardness due to tensile stresses when stress gradients are present is apparently smaller than it would be if uniform stresses of the same magnitude exist in the test piece.

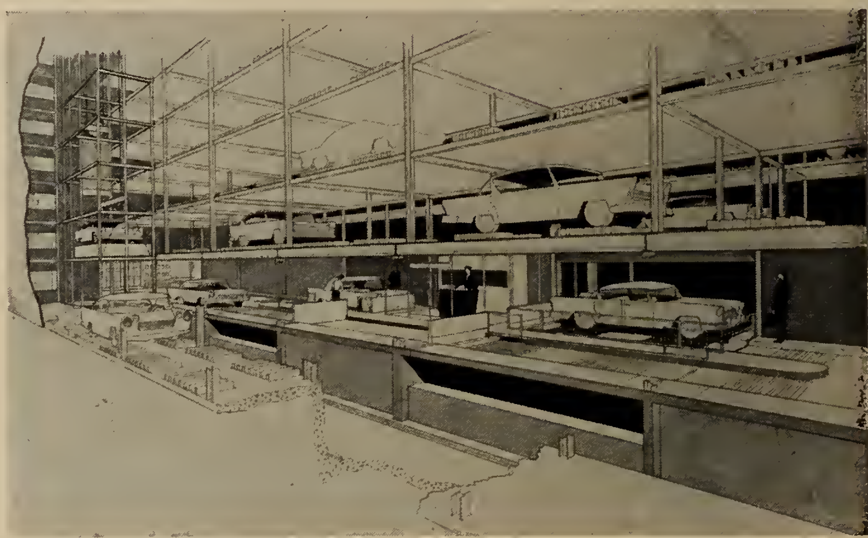
Polyethylene film is now widely used for various construction jobs. Above, it is being used in curing and protection of concrete on the New York Southern State Parkway. The film is made in Canada by Visking Ltd.



To get thin alloy steel sheets in so-far unobtainable widths, United States Steel Corporation has developed a sandwich rolling process (alloy steel between carbon steel sheets). Widths up to 90 inches have been produced, about twice that now available to aircraft fabricators, thus reducing the joins needed in assembly. The plates inside the sandwich are treated with a separating compound.



Described as the first completely automatic parking garage, a new eight-story structure being built in New York City is owned by Columbia University. Developers are Speed-Park Inc., and Otis Elevator Company are responsible for the equipment. The picture at left shows the operating principle. Below, at left are the incoming driveways from which cars are picked up by either of two travelling elevators and automatically taken to individual parking "lockers" on each of the eight floors. The process works in reverse to deliver cars to the outgoing driveways to the right of the central control panel. The single attendant acts only as cashier. Up to three cars a minute can be parked or discharged. The conveyors touch only the tires of the vehicle.



PAPERS OF THE INSTITUTION OF ELECTRICAL ENGINEERS

An Accurate Electroluminescent Graphical-Output Unit for a Digital Computer. T. Kilburn, G. R. Hoffman, and R. E. Hayes. (2241)

The paper describes a graphical-output unit fabricated from a uniform layer of electroluminescent phosphor with 512 parallel conducting strips on either side, these respective sets of strips being mutually at right angles to form a matrix of conductors. The application of a changing electric field between selected strips of both sets causes the phosphor to fluoresce at their intersection. As intersections are selected in turn a pattern can be traced out on the panel and recorded photographically. The discrimination ratio of brightness of wanted to unwanted spot positions and an improved method of biasing the matrix are considered in some detail. Other factors, such as driving-voltage frequency, waveshape and intermittent operation, are considered as they affect the discrimination ratio. Details of some prototype matrices are given, and a display indicating the resolution of such a system is shown.

Recent Developments in Medium Voltage H.B.C. Fuse Links. R. H. Dean. (2419)

The paper reports development work carried out in the investigation of fuse links of ratings up to 600 volts and 600 amp. in respect of basic problems of design when compliance with North American specifications and general circuit requirements is sought. Although this work was of a fundamental nature for universal application, it was stimulated by the publication of the Canadian Standards Association Code 106. Comparisons are made between this Canadian Code, the 'Standard for Fuses' used in the United States, and current practice in Britain, which centres on B.S. 88: 1952. Fundamental difficulties in fuse-link design are set out, leading to the choice of a design to satisfy general circuit requirements and the C.S.A. Code No. 106 in particular. Details of performance are given of the resulting range of fuse links. The results of the high-breaking-capacity tests carried out by the Canadian Standards Association are compared with the calculated figures.

Consideration is given to consistency of performance, and tests to demonstrate non-deterioration under service conditions are described.

A novel method is given for the rapid estimation of the effect of the fuse link in limiting fault power and energy admitted on severe fault conditions.

Investigations of Power Follow Current Phenomena Using a Synthetic Power Source. L. L. Alston and Prof. F. M. Bruce. (3553)

Criteria for the development of a power follow arc in a rod gap sparked over by the application of a high voltage impulse were investigated, using a synthetic power source. The latter comprised a tuned LC circuit, and could be adjusted to give a range of values for voltage, current, impedance, and frequency. The effects of these variables, and of the impulse waveform, on the development of power follow arcs in rod gaps up to 10 cm. spacing, are discussed.

INTERNATIONAL NEWS

Developments in Sweden

SOME RECENT NOTES on industrial development in Sweden.

Peak Steel Production in 1957

Sweden's steel output reached a new peak of 2,500,000 tons in 1957 and the value of exports, about $120,000,000, is the highest on record, according to Ragnar Sundén, managing director of the Swedish Iron-Masters' Association. However, the stock of orders has decreased and forecasts for 1958 are more difficult to make than in previous years.

In the period 1947-56 world production of steel rose by 80 per cent to 283 million tons, while Sweden's output was up by 100 per cent to 2.4 million tons. The largest expansion programme now under way in Sweden's steel industry is the Grängesberg Company's steel and heavy plate works at Oxelösund which, when completed by 1961, will have an output of about 300,000 tons of ships' plate.

Since 1954 Sweden's steel exports have doubled both in value and volume. The major part of exports is made up of high-quality steel for the engineering industry. Thanks to the wide geographical distribution of the quality steel exports, these are not likely to be seriously affected by a temporary business recession, while the fairly new exports of merchant iron and steel are having to face ever keener competition.

High Timber Production

With a probable total of about 1,050,000 stds., Sweden's exports of sawn and planed timber set a new post-war record in 1957, exceeding the previous peak in 1955 and being the highest since 1929, according to Knut Ronge, managing director of the Swedish Wood Exporters' Association.

This very satisfactory result, as far as quantity is concerned, has been largely due to particularly favourable circumstances. There was, for instance, considerably less competition from Finland and Canada than in previous years. Another factor favourably affecting the market was the unusually mild winter last year, which made it possible to lengthen the period in which timber could be shipped from Norrland during the winter months.

However, the economic return is generally found to be much less satisfactory. It is true that the price level remained unusually stable, but the margin of profit has been severely contracted. The costs of production have continued to rise and still further reduced the narrow margin.

Increasing Automobile Exports

Volvo, Sweden's largest automobile manufacturers, turned out 57,946 units in 1957, including 42,192 passenger cars, according to preliminary figures. The corresponding numbers for 1956 were 50,682 units and 31,260 cars. The turnover was up from Kr. 613,000,000 to Kr. 680,000,000 ($132,000,000).

Exports showed a new peak of 24,076 units, as against 16,996 in 1956. The largest increase was noted for shipments to the United States, which rose from 5,082 to 10,309 cars. Exports to Norway went up from 1,781 to 4,896 units. Denmark imported over 3,000 Volvo vehicles. Other major markets are Holland, Belgium, Greece, and South American countries.

For 1958 Volvo plans an increase in output of about 12,000 units, mainly passenger cars. Sales to the United States — so far primarily concentrated in the Pacific Coast — are likely to increase considerably also in the Middle West and the Eastern states, where it has hitherto not been possible to satisfy demand owing to shortage of cars. In Canada sales are handled by the Wenner-Gren-owned company Swedish Auto Imports, with which an agreement was signed August last. Shipment to Canada totalled about 100 units in 1957. It is expected that Canada will become an important market also for Volvo's trucks and lorries.

A record shipment of 1,000 Volvo passenger cars recently left Gothenburg on a 13,000-ton freighter specially designed to carry automobiles. The entire cargo was consigned to Los Angeles.

New Uranium and Heavy Water Plants

Sweden's atomic energy programme will receive Kr. 131,000,000 ($25,400,000) in appropriations under the 1958-59 budget estimates. Out of this sum the mixed Government-private company AB Atomenergi accounts for Kr. 112,000,000 and the Swedish State Power Board for Kr.15,000,000, while Kr.4,000,000 has been set aside for Sweden's participation in international atomic energy collaboration.

The appropriations to AB Atomenergi include funds for the continued construction of the company's research station at Studsvik, on the Baltic coast south of Stockholm, which will house the materials-testing reactor R 2 purchased in the U.S. and expected to be completed early in 1959. Work on the combined heat and power reactor R 3 at Agesta, which commenced at the end of 1957, is expected to be completed by 1960, when the reactor will supply heat and electric power to the Stockholm suburb of Farsta.

Initial funds under Atomenergi's appropriations have also been set aside for building a new and larger uranium extraction plant, a plant for plutonium production and an experimental plant for the production of heavy water.

Appropriations to the State Power Board are intended for the "Adam" atomic heating plant at Västeras, already decided on by the Riksdag, and for commencing work on the first Swedish atomic power plant, "Eve".

Water-Soluble Industrial Enamel

A water-soluble industrial enamel has been developed at the Swedish Becker paint industries. It is claimed to be the first in the world of its type to have been successfully manufactured on a large scale and has many advantages besides the one originally aimed at, of being fireproof.

Two types are a hard-finish product and a softer one which is specially adaptable for outdoor articles. The new enamel is also suitable for use as primer, having excellent adhesive and wearing properties. It is resistant to alkaline media and water after drying in a furnace.

Mixing vessels and spraying equipment can be cleaned by water, and the sediments used afresh. The same applies to losses in spray painting. Moreover, costs for ventilation and other details in the work-area equipment can be reduced, and the lack of organic thinners makes manufacture less hazardous.

(These notes are taken from information provided by the Swedish-International Press Bureau, Stockholm.)

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

The St. Lawrence Seaway and Power Project

Progress by Ontario Hydro

The month of December was generally favourable for construction work. The work force had been sharply reduced with the completion of some major contracts, and totalled 3,400 persons at year end.

A transfer from construction to operations activities was accomplished during December when the Iroquois control dam was turned over by the U.S. contractor to Ontario Hydro's regional operations staff. This staff now is operating the gates on this key structure.

Concrete placing continued over the power-house between units four and sixteen throughout December. By month end the total amount of concrete placed in the generating station was 880,000 cubic yards.

Construction of the first bank of transformer pockets was completed. Similarly concrete work for the terminal structure footings was finished ready for steel erection. Erection of the structural steel for the switchgear building was completed to unit four. The speed ring for the last turbine was installed and the pit liner was placed. On the upstream face of the power-house six headgates had been installed for units one and two. The heat pumps had been delivered and work of installing them was to commence in January.

Good progress was made on the rotors for two of the generating units. The laminations for unit one were expanded and keys driven. Technicians were ready to start installing the poles. On rotor three lamination work had been completed and ready for expansion and driving of keys. The No. 1 unit stator winding was completed and the winding for No. 3 stator was well advanced.

Work of installing the isolated phase bus for No. 1 unit commenced in December. Installing electrical starting equipment of headgate hoists for units one, two and three was begun. The erection bay and administration building had been completely closed in and work was proceeding on the interior installations.

At the St. Lawrence transformer station, the service building had been closed in with the installation of glass. The 230-kv. relay building (west) also had been closed in and work was proceeding in the interior of both buildings.

Grading proceeded in the extreme westerly section of No. 2 highway between Morrisburg and Iroquois in December but had been terminated at month end until spring. Work proceeded on several railway overpasses. Virtually all work on highway No. 31 overpass had been completed. Grading had been suspended on Carman Road, Crysler Park and Dickinson Drive overpasses.

Dredges worked until mid-December on Chimney Island, Galop Island and Cardinal contracts. All work had been suspended at Iroquois Point with the completion of the dragline excavation work. Good progress had been made on dry excavation at Point Three Points.

Opening or closing time of Iroquois lock sector gates to fill or empty the lock will be 5 minutes; its length is 768 feet; width, 80 feet; depth of water over the sills, 30 feet. It will provide access between the power pool in the International Rapids section and the stretch of river upstream leading through the Thousand Islands section to Lake Ontario. Lift of the lock will be 6 feet. ***Hans van der Aa photograph.***

The shopping centres in Morrisburg, Ingleside and Long Sault were opened in time for the Christmas trade. By year's end, all municipal services were completed for Iroquois, Morrisburg, Ingleside and Long Sault, including services, street paving and sidewalk building.

At Morrisburg the contract for the demolition of the old business section was awarded during the month. Construction of the United and Anglican Churches and manses continued in Iroquois. The building of New Iroquois town hall is now ready for the finishing work.

Progress by NYSPA

Concrete in place on all features totalled 1,917,000 cubic yards or 93 per cent of the estimated total. Excavation quantities had reached 48,800,000 cubic yards or 89 per cent of the required total. Employment averaged 2,570 for the month.

Long Sault dam cofferdam "E" was breached during December and the river again covered the Long Sault rapids area. With the breaching, stage II diversion was considered complete on December 11, 1957. Removal of Cofferdam "E" to elevation 190 was started. Removal of material from cofferdam "DD" continued.

The winter concrete placing program greatly reduced the concrete operations in December, being limited primarily to the intake structure and embedded turbine parts. All major concrete placements in the intake structure for six units were complete and the stayrings for ten of the turbines had been set. The generator rotor was placed in unit 32. Erection of structural steel in the 230-kv switchyard was 40 per cent complete.

Glass was being installed in the service building at Massena intake and interior painting was in progress. The contractor's warehouse and equipment are being removed from the site. Bricklaying, piping and electrical installations were in progress at the sewerage and water supply station at Waddington.

Channel improvements at Sparrowhawk Point, Toussaints Island, Leishman's Point and Ogden Island continued as total channel work on the project reached 94 per cent of completion.

Pole setting for seaway power facilities continued. On transmission lines between Barnhart Island and Plattsburgh, for the Reynolds power supply, and for foundations for the Barnhart-Adirondack transmission line north extension, foundations were being built, structures are being erected and conductor is being strung and sagged. Construction of the Plattsburgh substation vault walls was progressing. The contract was awarded for construction of the north extension of the Barnhart-Adirondack 230-kv transmission line.

Expediting continued on the remaining undelivered equipment to be used on the project. Eight turbines and five generators for the St. Lawrence power dam had been delivered. All other major items of equipment were being completed and shipped in accordance with the construction requirements.

Progress by SLSA

SLSA President Charles Gavsie, in a year-end progress report, announced that construction of the seaway had reached some 75 per cent of completion. The authority had awarded a total of 125 contracts, to a value of some $235 million. Twenty-nine of these had been completed. The work, he stated, was progressing satisfactorily.

Locks:

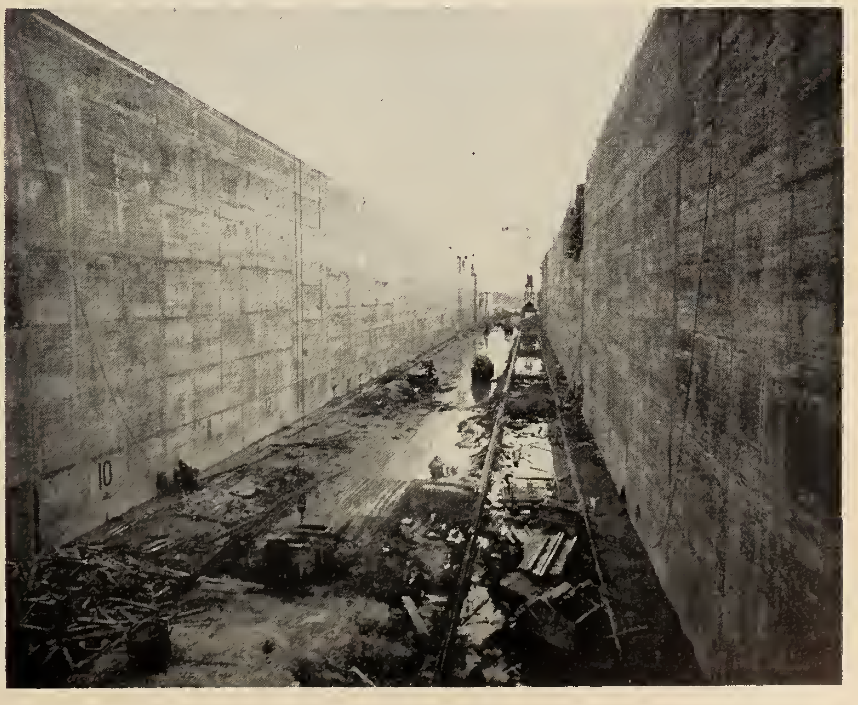
The most significant event, he said, had occurred on November 22, with the final test of Iroquois lock, most westerly of the new locks. This lock, with a six foot lift under normal seaway conditions, will provide access between the power pool in the International Rapids section and the stretch of the St. Lawrence upstream leading through the Thousand Islands section to Lake Ontario.

At St. Lambert lock, most easterly of the locks, last mass concrete was placed in December. Concrete for the main lock structure of the Cote Ste. Catherine lock was also all in place before year-end. The main lock structure of lower Beauharnois lock will be completed early in 1958 with the upper Beauharnois lock in late spring. Thus concrete work was 88 per cent complete at year-end.

Excavation and Dredging:

Contracts for dredging in Montreal Harbour, Lakes St. Louis and St. Francis, the channels at Cornwall Island and in the Thousand Islands section, and requisite reaches of the Welland ship canal must be partly suspended for the winter season. They will be resumed with the opening of the navigation season next April. Some 10.5 million cubic yards had been removed at year-end, for a completion figure at 56 per cent. Authority plans call for almost 21 miles of canal to be excavated "in the dry" and the total figure for dry excavation of all kinds is 55 million cubic yards Of this, 43.7 million

Looking down into the 80-foot-wide chamber of the Cote Ste. Catherine lock, second from seaward of seaway locks being built beside the Lachine Rapids, in the Montreal area. Locks will have a usable length of 768 feet. This is one of seven new locks for the seaway being built between Montreal and Prescott, Ont., to replace 21 on the old system. Canada is building five of the new locks. ***Hans van der Aa photograph.***



yards had been removed, or 78 per cent of the total.

Bridges:

Translation of the trans-channel span of the Jacques Cartier bridge took place in less than five hours on October 20. The southern portion of this bridge is being permanently raised to provide 120 foot overhead, clearance for shipping. The former deck-truss span was removed and a new through-truss span set in its place, thus providing 30 feet of the 80 foot increase in vertical clearance required.

New roadways and approaches on the south shore end of Honoré Mercier bridge were being constructed. For the support of these, concrete piers were built last year near Caughnawaga. Nearby work was well along for installation of two travelling lift spans for the double-track line of the Canadian Pacific Railway's Caughnawaga bridge.

At Victoria bridge, near the St. Lambert lock, the diversion of highway traffic was already accomplished. Lift spans were being installed on the main bridge for highway and rail traffic and on the diversion bridge, just upstream of the lock.

At Cote Ste. Catherine lock a service bridge of the bascule type is being built across the lock. A bridge of this type also serves to handle traffic across the lower entrance to the Iroquois lock.

The only highway tunnel under the seaway in Canada was opened to traffic in the summer of 1957. It is a four-lane tunnel, and carries highway No. 2 in two tubes under the seaway channel just upstream of the lower Beauharnois lock.

At the upstream end of the Upper Beauharnois lock, installations are being made for a swing bridge to carry the New York Central right of way over the seaway channel. Nearby, the Authority is building lift spans in two road and rail bridges crossing the Beauharnois canal. The substructure of a new bridge for highway traffic over the south channel of the St. Lawrence is also being built at Cornwall Island. The SLSDC is building the superstructure.

Operating Problems

As construction of major seaway facilities goes forward on schedule, planning for the operation and maintenance of the seaway is growing in importance as the time of opening approaches. The question of tolls, their probable quantum, method of application and collection is one which occupies much of the attention of SLSA officials.

The Canadian and U.S. entities announced last July that maximum vessel dimensions compatible with efficient operation, expeditious dispatch of traffic and with regard for the safety of navigation and property in the normal handling of seaway traffic are to be of an overall length of 715 feet and a beam of 72 feet. Ships with overall length of up to 730 feet and a beam of up to 75 feet can be accommodated subject to non-interference with other traffic.

Progress by SLSDC

With excavation for navigation channels practically completed on the American side, remaining rock removal still continued during December. All concrete had been placed in the Eisenhower and Grasse River locks. Installation of lockgates and machinery was progressing. A curved rock dike has been built downstream from the Grasse River lock to deflect water from the approach channel as it flows from Polley's Gut.

Foundations were being built for the new general motors Chevrolet plant downstream from the Reynold's metal plant site, where rapid progress was being made.

Other Seaway News

Plans are now before the government for improving four upper Lakes ports in time for the opening up of the seaway in the spring of 1959. They concern the Lakehead Cities, Sault St. Marie, Sarnia and Windsor. Biggest changes and most extensive works will be required at Port Arthur and Fort William.

The two ports chiefly affected by seaway opening are Windsor and Sarnia where new facilities will be needed from 1959. The deadline for improvements at the Lakehead and at "the Soo" comes only with the completion of dredging in the upper channels by the U.S. Corps of Engineers, scheduled for some time in 1962.

Difficulties surrounding the Lakehead improvements include — traditional rivalry between Port Arthur and Fort William; ownership by the two railways and exclusion of truck traffic; old railway terminals; existing wharves that cannot be dredged to 27 foot depth; existing ownership of the foreshore, calling for transfer of lands before new facilities can be built.

New President for SLSA

It was announced at the end of the year that Bennett John Roberts, chairman of Canada's National Harbours Board, would be the new president of Canada's Seaway Authority, replacing Charles Gavsie whose resignation was announced in October. Mr. Gavsie will resume the practice of law in Montreal.

Tolls

Eastern and midwestern U.S. interests are in a sectional conflict over tolls to be charged on the seaway. Traditional eastern seaboard opponents want the highest possible tolls to thwart traffic. New York City is not opposed to the seaway, but wants to see the project self-sustaining. Boston will object to any bargain rates. Railroads will fight against low tolls through a newly formed "National Committee for a Non-subsidized Seaway". A joint announcement by the United States and Canada on what the tolls will be is expected about March 1958.

Word from Washington late in November was that the U.S. and Canada were in agreement that there should be no tolls imposed on the seaway during 1958. It would not be fair or practical to charge tolls for an uncompleted project. 1958 would be a training period for manifest study and for recruitment of personel to serve in the collection of tolls.

Improvements at Chicago Port

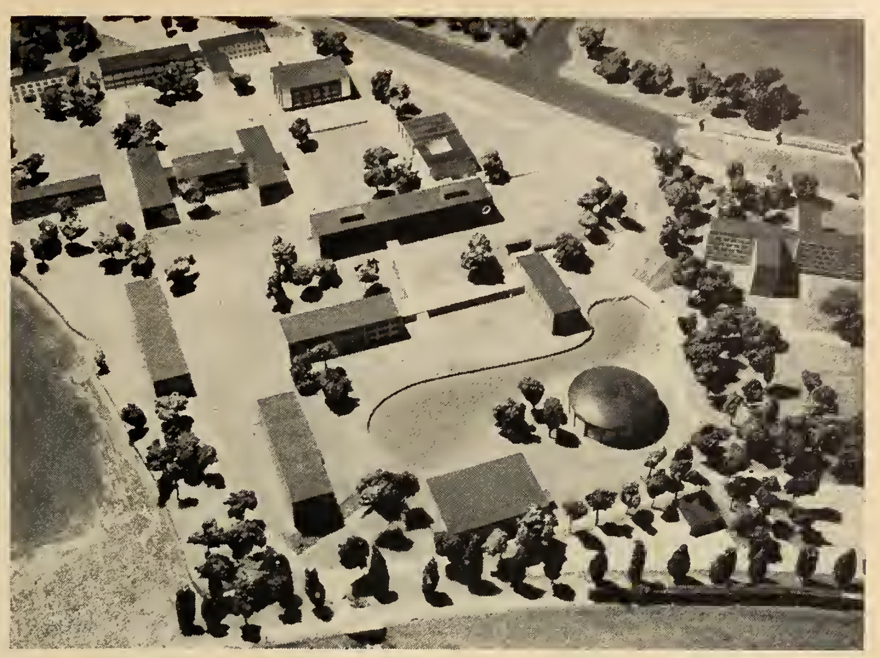
Contracts will be awarded early in 1958 for work on a $4 million improvement program at Navy Pier during the first half of 1958. Improvements will include two berths for ocean vessels south of the pier. This is the first phase of a $37 million program recommended by a marine engineering firm. The $4 million will be spent on the first two berths to give officials an idea of how much ocean traffic the new seaway is going to bring in.

SOUTHERN ONTARIO REGIONAL CONFERENCE

of seven E.I.C. Branches

See Pages 94-95 of this issue for program details

CARLETON UNIVERSITY building plan shown in architects' model (right) will develop the 130-acre Rideau River Campus to which the university will move next August. The Science Building is under construction now. It will house the engineering school and other science departments. The Library-Administration Building is under construction. The first section of the Arts Building should go to tender in a short time. These three will cost an estimated $4.5 million. A Students' Union, and an Administration Building are projected for some time in the future. These five buildings, which will make up the central court of the campus, will be the focal point. Student residences will soon be needed but are not projected for the immediate future. Carleton will spend $11 million during the next eight years for capital purposes, it is believed.



New Engineering Program at Carleton University

The *Journal* Reports Growth in Engineering Faculties in Canada

Second article of a series.

Carleton University in Ottawa established a new four-year curriculum in engineering in 1957, designed to suit the present conditions in our country and to prepare students for the assumption of increasingly important roles in society.

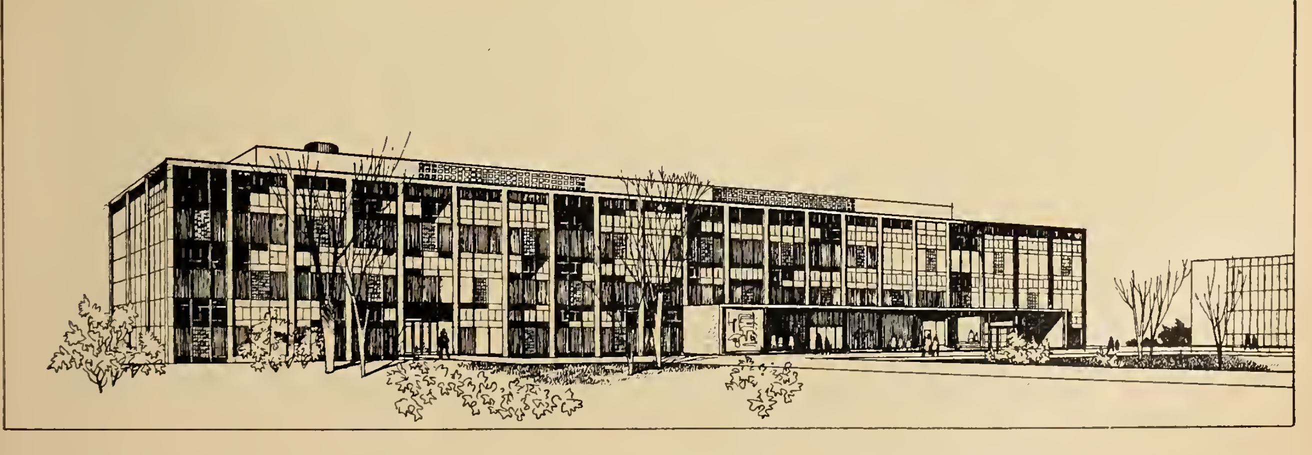
In setting up the new program, the university has established a School of Engineering under the directorship of Donald F. Coates, M.Eng. (McGill), M.A. (Oxford), P. Eng., M.E.I.C. Professor Coates went to Carleton from McGill University where in addition to his academic duties he was active as consultant on seaway, power and building projects.

The new Carleton course replaces the two-year certificate program. The university describes it as suitable for those students interested in careers in design, development, construction, production and operation in the fields of civil, mechanical and electrical engineering. It differs from many other university programs, however, in that it is less specialized. The specialization that does occur is principally in the fundamental subjects common to electrical, civil and mechanical engineering. In addition, study is required in a sequence of subjects in the humanities.

The university designed its engineering program to provide the graduate with the means for building up sound judgment as well as the basic engineering tools required for professional practice.

There are several reasons for offering a program of this sort, Professor Coates reports. Many students in their second or third years have no sound basis for choice among existing specialties, and many who graduate in one specialty find themselves practicing in another. A number of the larger companies would prefer graduates with broad fundamental

Henry Marshall Tory Building for School of Engineering and Science departments.



training. Furthermore, the increased specialization of modern engineering makes breadth of training at the undergraduate level a necessity.

Today there is also a trend to more design and project engineering being done by Canadian engineers for native enterprises. This is creating a greater demand for more highly qualified Canadian engineers. Furthermore, the rapid growth in industrialization has been accompanied by rapid change in engineering practices. Hence, in most fields engineering methods quickly become obsolete. Thus a large part of the undergraduate's time should be used in studying the fundamentals of the subject, in Professor Coates' opinion.

The engineer of today is assuming a more important role in society, and he is the individual that the community must look to for advice on technical-social matters. Consequently, it is considered important that he study the humanistic aspects of our society.

Professor Coates reported that 40 students had been enrolled for the new course by the middle of September. The first students will be graduated in 1961 with the degree of Bachelor of Engineering. Other faculty members in the School are assistant professor S. G. Tackaberry, C.B.E., B.A.Sc. (Toronto), M.E.I.C.; assistant professor E. E. Goldsmith, Dipl. Ing. (Berlin), D.I.C. (London), M.E.I.C., A.M.I.E.E.; and sessional lecturer Roderick C. McDonald, B.A.Sc. (Toronto).

An advisory council has been formed consisting of B. G. Ballard, M.E.I.C., vice-president (scientific) and director of the Division of Radio and Electrical Engineering, National Research Council; L. F. Grant, HON. M.E.I.C., field secretary, Engineering Institute of Canada; D. C. MacPhail, director of the Division of Mechanical Engineering, N.R.C.; J. H. Parkin, formerly director, now senior consultant to Division of Mechanical Engineering, N.R.C; K. F. Tupper, M.E.I.C., Ewbank and Partners, Engineering Consultants, Toronto; G. R. Turner, M.E.I.C., formerly chairman of Ottawa Branch, Engineering Institute of Canada; C. J. Mackenzie, HON. M.E.I.C., president of Atomic Energy Control Board and chancellor of Carleton University; E. W. R. Steacie, president, N.R.C.; C. T. Bissell, president, Carleton University; M. S. Macphail, associate dean, Faculty of Arts and Science, Carleton University; and Professor Coates.

Carleton University is planning to move next fall from its residential location in the Glebe area of Ottawa to a 130-acre campus about a mile and a quarter away.

Two buildings are under construction, the Henry Marshall Tory Building for science and the Library-Administration Building.

Target date for completion of the Henry Marshall Tory Building is August, 1958. It will house five science departments, including the engineering school.

The structure is being constructed on five levels, is 330 feet long and 60 feet wide, its estimated cost being $2,500,000. It is of reinforced concrete with curtain wall construction. The exterior will be of enamelled steel with large glass areas.

The building will provide accommodation for instruction and some research.

B.C. Electric Projects

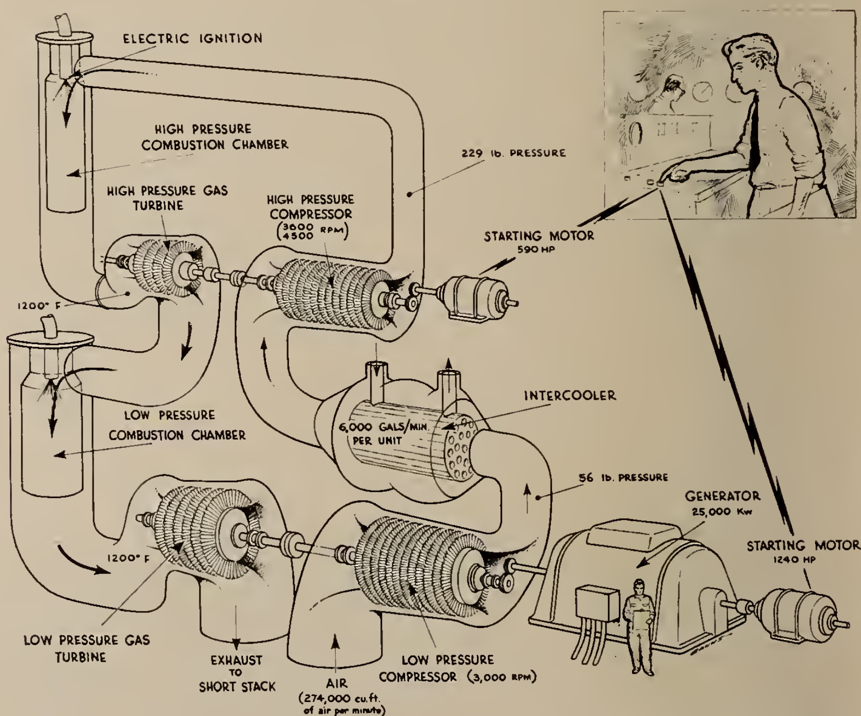
B.C. Electric's new $26 million Cheakamus hydro-electric generating project adds 190,000 horsepower to the power supply of the Lower Mainland and southern Vancouver Island.

Glacial waters were diverted westward, from the Cheakamus Canyon, at right angles into the Squamish River via a 6.7-mile tunnel under Cloudburst Mountain.

From the west portal of the tunnel, the water plunges 900 feet vertically through penstocks down the west slope of the mountain to spin two giant turbines in Cheakamus powerhouse on the Squamish River. The intake and east portal is near Garibaldi Station 22 miles north of Squamish.

Work on tunnel, dam and powerhouse was carried on simultaneously so that the whole project would interlock and be ready for service in late November 1957. The second of two generators came in line during December. More than 400 men were engaged during peak construction periods on various phases of the work.

Contracts were let during the winter of 1954-55 with Mannix-Stolte of Calgary and Oakland, California, successfully bidding as general contractor for the tunnel job. Mannix-Stolte went to work in April, 1955, assembling heavy equipment for drilling the rock face. Working around the clock, and with borings averaging about 80 feet a day, working from both ends



Cutaway drawing of the natural gas turbine generators to be installed at Port Mann, B.C., in 1958. Each unit will generate 2,000 kilowatts (4 units).

of the tunnel, on February 12, 1957 the crews met in the middle. Some 360,000 tons of rock had been cut from the depths of the mountain and at the power-house site.

Already work on the dam was well advanced by Emil Anderson and construction of the power-house and penstock foundations was underway.

The power-house, 140 by 70 feet, was contracted to Mannix-Stolte. It is as high as a six-storey building with an additional 40 feet below the ground. It is made of 6000 cubic yards of concrete reinforced with 750 tons of steel. The structure has an outside covering of corrugated asbestos. From the power-house a 14-mile transmission line carries power at 230,000 volts to Cheekeye substation, 11 miles north of Squamish.

By the end of 1957, operation of the Cheakamus plant was automatic. Its operation is remotely controlled by electric impulses from B.C. Electric's control office in Vancouver.

Canadian Westinghouse Ltd. built the two 95,000-hp. generators, the transformers, switchgear and control equipment. Westinghouse engineers report Cheakamus is the largest remotely controlled hydro-electric plant in the world, and it contains the largest remotely controlled generators.

Hydro electric generating stations at Clowhom (40,000 hp.), and at Lajoie (30,000 hp.), were also added to the system in November.

Port Mann, B.C.

The $13 million gas turbine thermal electric generating station steadily taking shape at Port Mann, B.C., will add 134,000 horsepower to B.C. Electric's generating capacity when the plant goes into service in 1958.

Structural steel for the powerhouse has been erected and work is proceeding on the roof and siding. Piledriving in the switchyard area has been completed, as have foundations for the steel towers.

Four 25,000-kilowatt turbines are on order from Brown Boveri in Switzerland and are scheduled to be delivered in time for the first unit to go into service in July and the fourth unit in November, 1958.

The station's electrical output will will be used to supplement the company's hydro-electric system during poor water years or when plants are shut down for maintenance or reconstruction.

The plant will receive natural gas at 300 pounds per square inch, through a 4-mile-long, 12-inch diameter pipeline from the main B.C. Electric gas line through the Fraser Valley, using a maximum of 40 to 44 million cubic feet a day for full operation.

Super-hot gases will be applied directly to the turbine blades of the generating units. No intervening step involving a boiler and steam will be required.

Storage facilities will be constructed to hold 3,500,000 gallons of fuel oil which will serve as stand-by fuel for the station. Foundation for the storage tank has been completed and construction of the tank has begun.

Canadian Pipeline Projects

West Coast Transmission

Westcoast's application to export gas from southwestern Alberta to the United States was being heard during November before the Alberta Conservation Board. Westcoast seeks to export 1,300 billion cubic feet, not to exceed a rate of 55 billion cubic feet per year over a 25 year period. Main opposition comes from Alberta and Southern Gas Co., which asks the Board's permission to export 450 million c.f.d. from Canadian Western Natural Gas Co. reserves, the East Calgary field and from several new Foothill discoveries, to serve San Francisco through a 1,300-mile pipeline. Hearings resumed the third week of January.

Westcoast management will move rapidly in the next two years to boost pipeline capacity to the peak permit level of 660 million c.f.d. from Peace River fields. This will call for expenditure of an estimated additional $55 million for further pumping capacity and the laying of extra gathering lines. But with expanded requirements both in B.C. and the U.S., plans are already being laid for a second 'big-inch' gas line to parallel the present one, once permits are available from Washington, Edmonton and Ottawa.

The bridge over the Little Smoky River on the Alaska Highway, which collapsed last fall, seriously hindering the transport of oil well and drilling supplies to northern B.C. gas fields, had been repaired by the Royal Canadian Engineers, Edmonton 25 Field Squadron. Replacing a ford across the river, a 46-ton 200-foot section of Bailey bridge was erected in less than four hours' time with a tractor and 47 men.

Another bridge on the highway across the Pine River north of Dawson Creek, carried away by ice early in December, was temporarily replaced at Christmas, permitting resumption of traffic.

Trans Canada Pipelines

With testing operations on Trans Canada's 34-inch line to Winnipeg fully completed, and with testing of the 85 miles of its 30-inch line to the Ontario border under way in December, gas was available to fill the Crown Pipeline's 310-mile section to Lakehead. The eastern section between Toronto and Montreal was also tested and would be ready for operation by year end or shortly afterward. Trans Canada will soon award contracts for its 491 mile stretch of 30-inch main pipeline between Kapuskasing and Toronto, scheduled for completion late in 1958.

A sixth blowout occurred on the Trans Canada pipeline on December 24, this one 30 miles east of Kenora on the Northern Ontario Pipeline Crown Corporation section. The pipe was repaired and operation resumed on December 27.

Northern Ontario Pipeline Crown Corporation

With Alberta gas available for testing the 310-mile section between the Manitoba border and Lakehead, this section was being purged and tested early in December. The unexpected long open fall weather had greatly facilitated construction and gas would be available to Lakehead cities for use this winter.

Awards of contracts for the 360-mile stretch between Lakehead and Kapuskasing were made to Nelen Ltd., Majestic Contractors, River Construction Corporation Ltd., Mannix Ltd., and Morrison-Shivers Ltd., in November. Bids averaged $10.19 per foot of pipeline, three times the average cost of $3.50 per foot for laying 24 and 20-inch pipe between Toronto and Montreal, and almost twice the $6.00 average for 34-inch pipe west of Winnipeg. The contract to Morrison-Shivers Ltd. averaged $16.03 per foot. Some of the unsuccessful bidders quoted $10 per foot higher than the award prices. The five contracts awarded total $20,827,789.

Tough ditching problems were probably the main reason for the high prices. One section passes through a 35-mile stretch of solid rock through the Precambrian Shield. This indicates that completion of the Trans Canada section between Kapuskasing and Toronto, except through the clay belt at its northern end, will also be expensive.

Pipeline News

British Columbia Electric Corp. will spend some $10.7 million in 1958 on gas trunk lines, distribution mains and gas extensions on the lower mainland and greater Victoria.

Winnipeg and Central Gas. Winnipeg city council in December turned down a C.C.F. proposal to expand the city's municipal hydro into the natural gas distribution field. But still in the air at year-end was the question of whether a second company, Great Northern Gas Utilities or Great Plains Gas Co., should also be allowed to distribute gas in the city.

Northern Ontario Natural Gas and Twin City Gas are planning expenditures of some $17 million in 1958 to bring gas to the rest of their marketing areas covering 34 communities between Kenora and Orillia, Ontario. Laying of distribution lines in Lakehead cities was nearing completion at year-end, as well as on the Kenora lateral. Work on all other municipalities will proceed in the spring, with completion scheduled for late 1958. Biggest undertaking will be the laterals from Trans Canada to Sudbury and Timmins, 82 and 31 miles long respectively.

Union Gas Co. of Canada has acquired all natural gas production and distribution properties previously operated by Dominion Natural Gas Co. of Brantford, which serves communities as far west as Leamington and Kingsville and south to St. Catharines and Port Colborne. Provincial Gas operating in Welland County and the Niagara Peninsula will in turn acquire Dominion's properties in Welland County and the Niagara Peninsula. Provincial Gas is a subsidiary of Consumers Gas Company.

Dominion Natural Gas, previously controlled by Cities Service Co. New York, owned 1266 producing gas wells and 1,750 miles of distribution lines. This deal will increase the stature of Union Gas considerably.

Union Gas is now nearing completion of the biggest expansion program in its history, including a 142-mile, 26-inch main pipeline from its Lambton County fields to Lisgar outside of Toronto where it will join up with Trans Canada. Through this artery, gas on loan from Union will supply communities east of Toronto as far as Montreal and Ottawa until arrival of Alberta gas late in 1958, to be paid back in kind over two years. Service was extended early in December to Guelph and Stratford.

Consumers Gas Co., for the third year of natural gas operation ending September 30, 1957, reports net profit 63 per cent higher than for the previous year. The company and its subsidiaries sold 14,884,000 m.c.f. of natural gas, compared with 3,584,000 m.c.f. in 1954.

Future capital expenditures could amount to $75 million over the next five years when natural gas from Alberta is available to areas not now served. Tennessee Gas meantime has agreed to allow the company to increase the flow it takes under contract to 60,700 c.f.d. Consumers plans expenditures of about $15 million during the coming year to bring gas to new municipalities in eastern and central Ontario, and for distribution in the greater Toronto marketing area.

Lakeland Natural Gas will spend $7½ million over the next five years for expansion to bring gas to 19 municipalities stretching from Port Hope to Cornwall. Installation crews have been working in Cornwall, Port Hope, Belleville and Gananoque and will have gas available to these areas by the first of January.

Quebec Natural Gas will be getting into full operation in 1958 with its huge conversion and expansion program on Montreal Island. Expenditures for 1958 are expected to reach $12 to $15 million. Conversion will begin in January 1958 and will take about 20 weeks to complete employing some 500 persons. Involved are gas appliances for almost 250,000 customers.

What Goes On

Island Airport Expansion, Toronto

First step in the program of expansion at Toronto's Island Airport was under way in November. The project is being carried out by the Federal Government under the terms of an agreement reached late in 1955, whereby the Department of Transport took over ownership at Malton Airport from the city. In exchange it agreed to provide additional facilities at the city's Island Airport which would make it one of the finest fields in Canada.

The Department of Transport had established traffic control in 1953. The following year 131,108 landings and take-offs were recorded, showing the Island Airport to be Canada's sixth busiest, though it was used largely for charter and training flights.

The Federal Government, has been operating Malton airport on the original wartime $1.00 a year agreement. Preliminary talks held between the Government and the Toronto Harbour Commission concerning the eventual disposition of the field developed the plan that the Government with its considerable investment should take over ownership as well as operation.

A new Island Airport 4,000-ft. runway, one third longer than the former one is being constructed at a different angle, to provide a clearer approach and take-off. A 36,000 square foot hangar will be provided to take care of the increased number of aircraft. Modern lighting will be provided to allow 24-hour operation of the field, if traffic warrants it. Fill, being pipelined to the airport to enlarge the field, is material removed during the dredging of the harbour western channel to post-Seaway depth.

Power Rental Regulations

Under the Water Resources Act, Alberta's new water power regulations governing the use of provincial waters for electric power generation, went into effect December 1, 1957. The new regulations follow closely those which formerly applied, especially in rental fees charged companies for the use of water. Water rentals are a form of levy based on horsepower year of electrical output, coupled with annual load factors.

Companies paid a total of approximately $100,000 in rent to the province in the last fiscal year.

CIR Reactor to India

The Canada-India Reactor, the heavy-water reactor which Canada has provided under the Colombo Plan, was shipped to India in December.

Similar in design to NRX and NRU reactors, the Canada-India reactor unit weighs 145 tons and stands 45 feet high. At the Indian reactor research centre three miles from Bombay, Foundation Company of Canada, chief contractors, with Indian help will assemble and install the reactor unit in a building now near completion. Atomic Energy of Canada Limited provided the design data and trained Indian technical personnel. Shawinigan Engineering Company of Canada were the prime contractors to supply the reactor and supervise its manufacture and installation. The hermetically sealed steel shell structure to contain the reactor is 120 feet in diameter and 135 feet high, to house a revolving crane that will remove spent fuel elements and replace them.

A little over half of the $14 million cost of CIR will be borne by Canada as a Colombo Plan contribution; India pays the balance.

Cossor (Canada) Ltd. Expands

Intended expansion of facilities or the erection of a completely new plant by Cossor (Canada) Ltd. in Halifax, has been forecast. Henry Chisholm of London, England, president of the company which works in the field of radar, communications, instruments and industrial electronics, has indicated that part of the present operations will be in new facilities within six months.

Cossor began operations in Halifax in 1948 with a working force of six persons. Personnel requirements have been as high as 315 at times of peak production, normally standing at 250. Chief among Cossor (Canada) Ltd. customers are the Department of National Defence, the Department of Transport, and the Defence Research Board. Working closely with the Royal Canadian Navy and Air Force, it operates a large research and development laboratory.

Pembina Flood Control

Initial construction began this fall on an extensive flood control program on the Pembina River, northwest of Edmonton. An Edmonton contractor completed the first diversion channel in December at a point southwest of Dapp. A series of short-cut channels is being designed by Water Resources Branch, Department of Agriculture. They will straighten out the tortuous course of the river and speed up the flow of water.

Two survey crews and an engineer spent several months last summer in preliminary survey work on the river. Their exhaustive studies laid the ground work for the construction program now begun. It is expected that tests and surveys may be finished late in 1958. Meanwhile, contracts will be let for diversion channels as engineers calculate the best location for each, and its specifications.

British Newfoundland Corporation

Work done so far on a uranium prospect 125 air miles north-east of Goose Bay, Labrador, indicates it might support a mining operation in the order of 200 tons a day, the British Newfoundland Exploration Ltd. announced in December. The find, known as Kitts prospect is on the south shore of Kaipokok Bay, between the settlements of Postville and Makkovik. A mile from the sea and at the same latitude as Knob Lake, Que., it is the first underground exploration in Labrador, and the first mining operation of any kind on the Labrador coast.

British Newfoundland Exploration Ltd., (Brinex), is a wholly-owned subsidiary of British Newfoundland Corporation Ltd. A decision to place the prospect in production would take into account the factors of methods and costs of ore extraction the extent of reserves and the marketing prospects.

British Newfoundland Corporation also reported progress in other fields. This year's extension of the original engineering studies disclosed that a development could be begun on the Hamilton River in Labrador on a scale as low as 100,000 kw. This could be accomplished by temporary diversion of the Hamilton into the Valley River. This increases flexibility and should ease the task of building up sufficient demand for power to justify construction.

The intensive investigation of the power potential in the Bay d'Espoir region of Newfoundland proper was completed during the year. The results of the survey will be available shortly. Preliminary indications are that some 350,000 horsepower at the site can be developed simply and economically in stages of 70,000 horsepower. The company is in a position to quote a price for power to consumers and to start development when justified.

Calgary Power Limited

To supply Alberta's growing power needs Calgary Power Limited in 1957 continued its program of expansion of generation, transmission and distribution facilities, and rural electrification, the company reported at year end.

More than 700 miles of transmission and distribution lines were added in 1957, half of them extensions to serve oil fields. A 69,000-volt interconnection with the City of Edmonton will replace the former 13,800 volt interconnection. One of the 138,000-volt lines between Ghost hydro plant and the East Edmonton substation is being strengthened by 60 per cent. The company's non-profit subsidiary, Farm Electric Services Limited, brought another 2,000 farms into the rural electrification program.

The Cascade plant extension, near Banff was completed in September, doubling the plant's capacity by addition of 23,000 hp. to the system. Work began on the Rundle and Spray plant extensions, (adding 40,000 hp. and 62,000 hp., respectively) to be in operation late in 1959.

Work on extension of the Wabamun steam plant was completed. The second unit will go into operation in autumn, 1958, a duplicate of the first 88,000 hp. unit installed in 1956. A third unit is scheduled for 1961. The cost of expansions at Cascade, Rundle, Spray and Wabamun is estimated at $30 million.

Public Works' Providing Employment

The Federal Department of Public Works has under way at the present time a total of 1,426 different types of projects which will cost something over $100 million to complete.

"The Federal Department of Public Works is actually setting an aggressive pace in the provision of work which is giving employment during the present winter months and continuing through the months ahead," Hon. Howard Green, Minister of Public Works stated in a December release.

"Wherever possible," the Minister went on, "inside maintenance work which might have been started or completed during the summer months was held in abeyance in order to provide additional employment through our works program during the winter months."

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

The Elections Act

Proposal to Amend the Canada Elections Act
(Voting at Advanced Polls)

Under this heading Bill Number 6 of the House of Commons of Canada was given its first reading on October 16, 1957. Members of the profession from coast to coast should be interested in this proposal.

The Institute's interest in the subject started with an exchange of letters early in the year with the then Prime Minister. This exchange ended in a flat denial from the Department that there was any need to extend the privileges of the Advance Poll, and that such an extension if authorized would produce unsatisfactory results.

The privilege of advance polls up to now has been limited to a very small group, "commercial travellers, fishermen, persons employed upon railways, vessels, air ships, etc., members of the reserve forces, the R.C.M.P., etc.".

It has seemed unreasonable that this privilege should be restricted to a small section of the population. If any citizen finds it impossible to be home on election day he should not be deprived of the right to vote.

The Institute was not satisfied with the reply from the Government and solicited the support of other organizations and again appealed to the Minister. Before any reconsideration of the proposal could be made the Government was out of office.

At the annual business meeting of the Institute in Banff on June 12 several members voiced their displeasure at having missed voting on June 10 because they could not use the Advance Poll. In fact it appeared that a thousand people at that meeting had been disenfranchised as far as this particular election was concerned.

The meeting instructed the general secretary to continue the efforts to have the Act changed. Accordingly a telegram was sent the same day to Mr. St. Laurent with copy to Messrs. Diefenbaker, Coldwell and Low, urging action. Herewith is the petition:—

"The Engineering Institute of Canada at its Seventy First Annual Meeting today passed unanimously the following resolution. In view of the fact that members of the profession of engineering in Canada are required on many occasions in the ordinary execution of their duties to be absent from their homes on election day it is unanimously agreed that the Federal Government be requested to so revise the Election Act that the privilege of voting at the Advance Poll be extended to engineers and others similarly situated. It is the very essence of democracy and in the best interests of Canada that no citizen be denied his fundamental right for any reason. The very existence of the Advance Poll proves the truth of these statements but it is an injustice to limit its application to so few citizens. For example here at this Banff meeting arranged five years ago there are one thousand voters all of them disenfranchised for the recent election."

The clause in the proposed amendment which is of interest to engineers, and to others as well, reads this way.

"95 — Any elector whose name appears on the list of electors prepared for a polling division comprised in an advance polling district who believes that he will for any reason be absent from and unable to vote in such a polling division on the ordinary polling day at a pending election may vote at the advance polling station established in such district if, before casting his vote, he takes and subscribes to an affidavit for voting at an advance poll, in Form No. 66, before the deputy returning officer of such district".

Of course it is impossible to tell in advance what will happen to such proposals but in view of the fact that many organizations have petitioned the Government for the change it is hoped that good results will accrue.

Among the other organizations known to the Institute to have petitioned the Government along these same lines are — The Canadian Chamber of Commerce, the Chemical Institute of Canada, and the Canadian Institute of Mining and Metallurgy.

Southern Ontario Regional Conference

Seven Institute branches will participate in the Southern Ontario Regional Conference of the E.I.C., to be held in Hamilton, Ontario on March 15, 1958. The Hamilton Branch conference committee has organized an attractive program with the full cooperation of Headquarters. For program details see pages 94 and 95 of this issue.

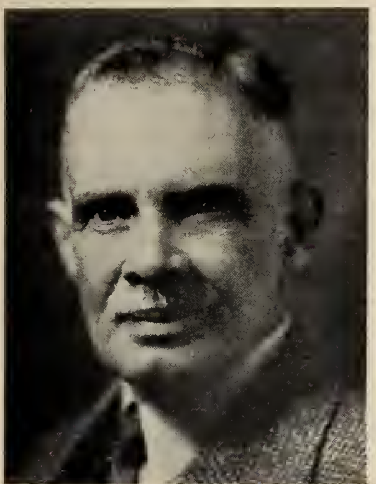
At the November meeting of Council it was agreed that some financial support be made available for the promotion of such regional meetings organized and conducted by branches of the Institute.

Grants are primarily intended to provide such services as printing, publicity, mailing, and the provision of technical papers and speakers, and branch officers have been encouraged to consider the holding of regional technical meetings in other areas.

Colonel Grant Retires

Members all over Canada will regret to hear that Past-President Leroy F. Grant, HON. M.E.I.C., who for almost eight years has been field secretary for the Institute at Toronto, has retired from that post.

There are few engineers who are so well and so favourably known across this broad Dominion as is Colonel Grant. Affectionately known by all his friends as "Leary", he has travelled Canada from coast to coast and made frequent trips to the United States in the interests of the Institute.



L. F. Grant, HON. M.E.I.C.

A chronological account of Colonel Grant's activities within the profession would not begin to tell the story of the success of his career. There are engineers whose technical achievements have been greater than his but so far as this writer knows, there are none whose personal success surpasses his.

The circumstances of Colonel Grant's assuming the office of field secretary are interesting and tell something of the man himself. After the sudden death of C. E. Sisson who was the first field secretary at Toronto, the Institute experienced difficulty in locating a successor. Colonel Grant was approached but for good and sufficient reasons declined the appointment.

However after many months had passed without finding a suitable replacement, he volunteered at considerable sacrifice, to take the post for one year pointing out that during that time he would locate a successor for himself who could carry on the good work.

As anyone who knows Colonel Grant would appreciate, it is no easy task to find a successor to him. Suggestions which were made from time time proved to be unacceptable, consequently Colonel Grant occupied the post for approximately seven and a half years.

Each year throughout that period he has suggested that the Institute retire him, but because the Institute did not wish to retire him and because he did not insist on it, he was held in the office year after year. Finally it had to be recognized that his request must be granted, and so with Colonel Grant's assistance a successor has been found and has been working with Colonel Grant through the Toronto office since the first of October.

In looking back over the record of service to the profession and to the Institute one must not overlook the work which he did in the United States through the Engineers' Council for Professional Development. For many years he was on committees there representing the Institute and for the last three years of his service was the president.

One of the great dividends the Institute has received because of this service is the establishing of the Institute in the high regard of the profession in that country and the acquiring of a great host of warm personal friends. No one but Colonel Grant could have accomplished these things so thoroughly and in so short a time.

A feature of the field secretary's work has been his interest in what he has called "the orphan groups" by which he referred to those members who were not located in the larger centres which represented the geographical centre of a branch. He visited such groups from one end of the country to the other and did much towards improving relationships between them and the Institute. In fact these meetings of his have led in many instances to formation of branch sections and even of new branches.

Professional Development

Another achievement in the life of the Institute is the program of professional development courses carried out by branches across Canada. These are definitely the product of Colonel Grant's efforts. He made the proposal in the first instance and he has fostered the efforts ever since. His imprint is clearly stamped on every meeting and every lecture of every course. Few things the Institute has done have proven as popular and as useful.

The good wishes of the members of the Institute go with Colonel Grant; all will regret the necessity of his retirement but will wish him continued good health and long life to enjoy the retirement which he has so richly deserved. His contributions to the profession cannot be counted, but in the minds of many people they are among the greatest made by any engineer in this country.

No mention is made herein of the many things Colonel Grant did for the Institute outside of his services as field secretary. That is another story; but in further recognition and appreciation of his achievements a short biographical sketch follows:

LEROY FRASER GRANT was born in Toronto; he was educated at St. Alban's School and Royal Military College, from which he graduated with honours in 1905. In 1926, while teaching at R.M.C., he received the degree of B.Sc. with honours from Queen's University.

He was appointed to the Royal Canadian Artillery in Halifax in 1905. Resigning from the Army in 1907, he worked in British Columbia for seven years, first with the Grand Trunk Pacific Railway at Prince Rupert, and later with the consulting firm Ducane, Dutcher and Company in Vancouver. At the outbreak of war in 1914, he was granted a commission as captain and adjutant in the Canadian Overseas Railway Construction Corps. Two years later he transferred to the 5th Battalion, Canadian Railway Troops as second in command with the rank of major.

After the war, Major Grant returned to British Columbia and worked until 1921 for the provincial Department of Lands and Surveys. Then he returned to Royal Military College as an instuctor in engineering. Two years later he became associate professor, an appointment he retained until 1940 when he re-entered the Canadian Army. While at R.M.C. he commanded the 32nd Field Battery, and later the 9th Brigade, Canadian Field Artillery. He was promoted to lieutenant colonel in 1937. In 1940 he was appointed general staff officer, first grade, for Military District No. 3, Kingston, remaining in that post until he retired in 1944. He then went to Queen's University as a special lecturer and was appointed associate professor of engineering in 1946. He retired in 1949.

Colonel Grant was chairman of the Kingston Branch of the Institute in 1925; secretary treasurer of that branch, 1928 to 1937; councillor, 1938, 1939, 1940; vice-president for Ontario, 1943, 1944; president, 1947. He holds the honorary degree of D.Sc., awarded by Laval University.

SOUTHERN ONTARIO
of The Engineering
Sheraton Connaught
Saturday,

SOMETHING NEW!!

This Regional Conference is the first of its kind sponsored by the E.I.C., and all Southern Ontario E.I.C. and A.P.E.O. members and their ladies are urged to attend. A special Hamilton Branch Conference Committee has made comprehensive plans and arrangements for your pleasure and convenience. The guest speakers, papers presentations, and social program will be stimulating and enjoyable for both the engineers and their ladies, and the conference will afford an opportunity to meet and mix with members from all seven Southern Ontario Branches.

11.00 a.m.	**MEZZANINE FLOOR**	**REGISTRATION** Advance registration and hotel accommodation forms will be mailed to all members
12.30 p.m.	**MAYFAIR ROOM**	**MEN'S NOON BUFFET** After registration the men are invited to assemble in the Mayfair for informal introductions and discussions prior to lunch
1.30 p.m.	**SHERATON ROOM**	**GENERAL ASSEMBLY AND WELCOME FROM THE HAMILTON BRANCH**

1.35 p.m. **SHERATON ROOM** **AFTERNOON GUEST SPEAKER**

The Impact of Television on Canadian Life — Today and Tomorrow,

J. A. Ouimet, B.ENG., D.SC., M.E.I.C., P.ENG.

Dr. Ouimet, the general manager of the Canadian Broadcasting Corporation, is a pioneer of television in Canada. He became one of the first to work in television research on leaving McGill University in 1932. In view of so long and so close an association with this medium, Dr. Ouimet's views on the impact of television will be well worth hearing.

2.40 p.m. **SHERATON ROOM**

Engineering Applications of Reinforced Plastics

H. R. CHIPMAN, B.SC.,
Supervisor of Plastics Development,
Naugatuck Chemicals Limited, Elmira, Ontario

For some years Mr. Chipman has been responsible for Plastics development and for technical applications of reinforced polyesters. His paper will deal with the high strength, corrosion resistant, and high impact resistant properties of this new construction material.

2.40 p.m. **ORIENTAL ROOM**

Heat Wave

F. R. DENHAM, B.SC., PH.D., M.E.I.C., P.ENG.,
Electro-Metallurgical Co. of Canada Ltd., Welland, Ontario

Dr. Denham will describe a revolutionary development in heating equipment which will soon be marketed in this country. The heater, which operates on the wave principle, is self aspirating, needs no external source of power and operates at efficiencies in excess of ninety-five percent.

3.45 p.m. **SHERATON ROOM**

Rail Steel as a Medium for Reinforcing Concrete

N. A. EAGER, B.SC., M.C.E., M.E.I.C., P.ENG.,
President, Burlington Steel Company Limited, Hamilton, Ont.

A major producer of reinforcing steel, "Burlington" contributes to the research and development that has kept reinforced concrete a prime construction material. Mr. Eager's presentation will be copiously illustrated with films, one of which will show the effects of atomic blasts on different types of construction.

3.45 p.m. **ORIENTAL ROOM**

The Engineering Approach to Municipal Traffic Problems

H. F. BURNS, B.SC., M.E.I.C., P.ENG.,
Traffic Engineer, A. D. Margison and Associates Limited, Toronto, Ontario.

A director of the Canadian Section Institute of Traffic Engineers, and Chairman of the Traffic and Operations Committee, Canadian Good Roads Association, Mr. Burns is fully conversant with the urgency of present day traffic problems. He will have some interesting suggestions for their solution.

All E.I.C. and A.P.E.O. members and their

REGIONAL CONFERENCE
Institute of Canada

Hotel, Hamilton
March 15, 1958

SEVEN BRANCHES PARTICIPATING ! !

Southern Ontario has one of the heaviest concentrations of engineers in Canada with over 3300 E.I.C. members in the seven participating Branches. In addition, there are a tremendous number of A.P.E.O. members in this same area, all of which makes it ideal for a Regional Conference of this nature. The participating branches are BORDER CITIES, HAMILTON, KITCHENER, LONDON, NIAGARA PENINSULA, SARNIA, TORONTO.

6.15 p.m.	ORIENTAL ROOM	RECEPTION AND COCKTAILS AS GUESTS OF THE HAMILTON BRANCH
7.00 p.m.	CRYSTAL BALLROOM	CONFERENCE BANQUET

8.30 p.m. CRYSTAL BALLROOM — EVENING GUEST SPEAKER

Back Talk from the Rumble Seat,
J. Lance Rumble

Mr. Rumble has been employed with General Motors Corporation for the past thirty years and is presently General Manager of the Toronto Retail Truck Branch. He has given over one hundred talks per year for the past ten years which is ample testimony to his well-known humorous speaking ability.

9.30 p.m.	CRYSTAL BALLROOM	E.I.C. REGIONAL CONFERENCE BALL CHRIS LOVETT AND HIS ORCHESTRA Dress Optional

For information — contact the nearest E.I.C. Branch Executive member or R. H. Stevenson, General Chairman Conference Committee, c/o Canadian Westinghouse Co. Ltd., Sanford Ave. N., Hamilton, Ont.

For the Ladies!!

11.00 a.m.	Brittany Suite—Registration Coffee Hour
12.30 p.m.	Buses leave hotel for Canadian Westinghouse Auditorium
1.00 p.m.	Noon Buffet Luncheon
2.00 p.m.	Spring Revue

SPECIAL NOTE: — The Hamilton Branch E.I.C. Auxiliary and Wives of Professional Engineers will be hostesses to the ladies during the special afternoon program. This group has also made special arrangements to provide dressing accommodation in their homes for the visiting ladies who will not be staying overnight at the hotel. In addition, the Brittany Suite at the Sheraton Connaught will be available for the ladies throughout the Conference.

ladies are cordially invited. Plan to attend!!

Survey of Scientific and Technical Manpower

The Department of Labour of Canada is at present surveying professional men and women in scientific and technical fields. The purpose of this survey is to bring up to date records of the National Register of scientific and technical professions which have been maintained by the Department since 1942.

The current survey is part of a program in which one-third of the people in scientific and technical professions will be surveyed each year. By this means, information on scientific and technical manpower in Canada will be maintained on a current basis. Those surveyed each year are selected on a random basis thus permitting the information secured to be used as a statistical sample representing the whole group.

Thus, the analysis of Register records will provide a basic source of information on the characteristics of the supply of scientific and technical manpower, such as its age composition, its geographic location, the fields, of specialization and function within each field, education received and income earned.

The E.I.C. fully endorses the main tenance of the National Register of scientific and technical professions and the survey program being undertaken and asks that all members who have received the questionnaire form this year co-operate fully in giving prompt and accurate returns to the Department of Labour, Ottawa.

Structurals Celebrate Fiftieth Anniversary

The Institution of Structural Engineers (Great Britain) will be celebrating its fiftieth anniversary from the 7th to the 10th of October, 1958.

An invitation has been received for the Engineering Institute to be represented formally and officially at the celebrations and Council has accepted the invitation and in due course will select a delegate or delegates. Members also are invited and it is hoped many will avail themselves of the opportunity.

It would be appreciated if members of the Institute who plan to attend the conference would advise Headquarters so that an official tie-in between the delegate and the Institute can be established.

The program for the semi-centennial will cover the whole field of structural engineering under the following headings:—

1) Research, fundamental and applied
2) Single-storey structures
3) Multi-storey structures.
4) Bridges
5) Power stations (including dams)
6) Mine structures
7) Storage structures
8) Airports, docks and wharves
9) Foundations
10) Miscellaneous — any subject not covered in 1 to 9 above.

THIRTY-FIVE YEARS AGO

Comment on the Journal of February, 1923

In the February 1923 issue of the *Journal* more than half of the contents was devoted to the Report of Council for the year 1922. Council recorded a growing strength of the branches and a growing interest in branch meetings. September had seen the establishment of the Lakehead Branch embracing the cities of Fort William and Port Arthur. The financial statement showed an operating surplus. Membership totalled 5,127.

Passing of the Professional Engineers Act of Ontario in June 1922, and an amendment to the Act governing the practice of the profession in Quebec, requiring graduates of Ecole Polytechnique and McGill University to join C.P.E.Q., were recorded. Tribute was paid to Arthur T. St. Laurent, M.E.I.C., president-elect of the Institute for the year 1923.

J. G. Sullivan, M.E.I.C., in his address as retiring president, presented at Montreal in January 1923, referred to the subject of "Labour and Capital". The use of capital, he pointed out, was to make living more easy and increase the comforts of life, and no fault could be found with it. 'Labourers' included every person creating or assisting in the distribution of the world's goods.

But labour organizations did not live up to their objective of bettering the conditions of the working man in the speaker's opinion. They had created unrest, hatred and distrust in the minds of their members. Union rules restricted the kinds of work a man might do . . . The professional labour leader was the guilty party . . . The closed shop denies the brotherhood of man.

"Stop toadying to labour unions and take your employees into your confidence", he urged. A year before, at the invitation of the then Minister of Labour a meeting had been held at Ottawa of interests employing 145,000 men, all working under the Industrial Council Plan. This had been a good beginning for Canada, he declared. If engineers were to give this matter the study their personal interest in the subject deserved, the time would arrive when co-operation would take the place of hatred, distrust and discontent.

Outstanding items appearing in some fifteen pages of Branch News recorded the opening of the Longueuil plant of Armstrong Whitworth of Canada Ltd., for manufacture of pulp and paper machinery and hydraulic machinery, and placing in operation of the first unit of the Manitoba Power Company's 168,000-hp. development at Great Falls on the Winnipeg River.

At the annual banquet of the Calgary Branch, attended by 70 members and noted as the best in its history, G. W. Craig, M.E.I.C., as retiring councillor summing up the progress of the Branch during the past year, remarked each member should use the 'Code of Ethics' as a standard of guidance in his relations with those he meets in the practice of his profession.

He then quoted in part a poem by Colonel Robert Isham Randolph, M.E.I.C., a parody on Kiplings 'If' which summed up our ethics:—

If you can give yourself and all that's in you,
And make the others give their own best too,
If you can handle men of brawn and sinew,
And like the men and make them like you too;

If you can boast a college education,
Or if you have a sheepskin, can forget;

If you get a small wage for compensation,
And give a little more than what you get;
If you can meet with triumph or disaster,
And treat them without favour, nor with fear,
You'll be a real man and your own master,
But what is more, you'll be an engineer.

H.G.C.

Did You Know That . . .

There are 49 branches of the Engineering Institute. The first was formed in Toronto in 1890, the second in Cape Breton in 1905, and the latest two in Seven Islands and Baie Comeau in 1957.

Across Canada there are over 700 people serving the Institute as branch officers and members of committees. Sixty-eight councillors and six vice-presidents represent the members on the Institute Council.

Elections and Transfers

A number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected at the meeting of council on December 13, 1957.

Members: A. T. Balfour, London; W. A. Dodds, Edmonton; J. M. Carbert, Trail; H. E. Farnam, Seven Islands; J. K. Kitching, Montreal; J. N. Landis, San Francisco; F. D. Ledgett, Toronto; R. R. Lee, Leamington; G. E. Midgley, Edmonton; J. R. Naismith, Toronto; G. A. Oravas, Venezuela; W. J. Shortall, Peterborough; Z. Todorski, Arvida; E. W. Vaughan, New York; E. E. Ward, Maitland; C. R. Young, Sarnia.

Juniors: D. C. Bellow, London; D. R. Gilham, Hamilton; L. L. Johnston, Belleville; M. Karpa, Hamilton; D. R. Morrison, Copper Cliff.

Junior to Member: C. B. Crawford, Ottawa; W. E. Donahoe, Fredericton; D. W. C. McEwan, Cornwall; W. E. Stone, Vancouver.

Affiliate: C. J. Robbins, Montreal.

STUDENTS ADMITTED:

McGill University: D. I. Abramovitch; C. R. Adams; N. Agensky; S. V. Allison; E. J. Altinalmazis; H. D. Alvo; V. J. Alway; J. M. Anderson; A. J. R. Armstrong; M. R. Artola; R. J. Austin; S. W. Bain; J. Baziw; N. S. Bedford; M. H. Belanger; R. C. Berry; A. E. Bethune; A. J. Birchenough; J. E. Black; W. M. Blaiklock; G. Blais; J. A. Blais; A. J. Bobkowicz; B. Bonneau; W. H. Booth; L. R. Bourassa; J. L. A. Bourbeau; D. G. Bourdon; J. E. Bradley; N. R. Breton; W. L. B. Briggs; G. R. Brighton; L. Bronstein; A. E. Brown; B. Brown; R. Brunet; S. L. Butkovic; J. W. Butler; K. K. Butler; S. Butman; J. R. Buzek; W. H. Cameron; W. R. Campbell; D. E. Cape; M. G. Cape; G. J. Carbonneau; H. Chang; W. P. Chen; P. O. Clark; M. B. Cockerline; G. J. Cohen; A. R. Copeman; D. J. Costantini; E. D. Crook; J. X. Jacques Cyr; B. Denis; G. A. Desbarats; J. G. Descary; G. F. Dionne; R. M. Dionne; A. E. Douglas; J. M. Dow; M. R. Dulepka; D. W. Dunkerley; N. L. Ede; R. D. Elliott; M. A. Faris; L. C. A. Feher; M. Fels; J. D. Finch; N. E. Florakas; A. W. Flynn; L. Frichetstun; S. R. Friedman.

L. L. Gagne; A. J. Gillies; M. Gitelman; V. Goba; L. Gordon; H. M. Gouverneur; I. Graif; M. R. Green; A. W. Greig; K. Griffiths; A. V. Grove; M. S. Guimont; C. D. Hall; D. G. Haltrecht; R. A. Hango; D. S. Harris; G. A. Helm; W. B. Horwood; D. F. J. Hudson; A. Hutchinson; W. R. Hyman; A. Ibrahim; S. C. Janco; E. C. Johns; N. R. Jones; A. J. Kibrick; L. Kostaszek; D. C. V. M. Krupka; E. Kuhnert; A. Lachapelle; J. F. P. Lalonde; K. V. Lapinas; P. R. Lavallee; W. A. Lawrence; R. G. Laxson; P. Lebeau; P. L. Leblond; J. P. Ledoux; G. H. Leduc; A. Lee; M. Leitman; A. Lenkei; D. P. L'Esperance; A. K. Leung; A. Levine; M. D. Levine; I. Lewis; B. M. Lipski; A. Litman; S. Louie; D. W. MacEwen; G. H. MacEwen; I. C. MacInnes; B. W. Mackenzie; D. J. Mactaggart; G. F. Maloney; D. W. L. Maltby; B. J. Margolese; L. Marineau; D. J. Martin; R. D. Martin; E. Master; D. G. Mathewson; S. M. Matin; E. Mazliach; W. B. McAdam; J. D. McCallum; F. T. McDonnell; G. R. McFarland; D. H. McKay; W. B. McLachlan; W. A. McLaren; P. G. McNamee; B. Meltzer; J. R. Menard; S. F. Mester; G. J. Meunier; G. H. Meuris; G. A. Milette; W. W. G. Miller; C. Mirza; H. Mitchell; D. Mongeau; O. Monkewich; I. E. Morrison; L. Najman; R. J. G. Nantel; C. W. Nelson; J. B. Nelson; J. Nev; T. M. Netterfield; H. W. H. Ng; D. K. Nimetz.

M. U. Oko; J. F. O'Rourke; R. D. O'Sullivan; S. Pandit; G. Payette; F. R. Penney; G. E. Pfaefflin; J. N. Pretty; R. Purre; H. N. O. Quao; P. Quevillon; R. A. Raimi; M. D. Rapkin; H. E. Reece; R. I. Renton; J. H. P. Richard; R. J. G. Richard; J. M. Rieffel; E. G. Riley; B. E. Riseborough; D. R. Roberts; A. H. Romano; Y. Roy; M. J. Russ; R. D. Saunders; R. R. J. Sauve; B. E. Scarvelis; E. V. Schaubel; D. J. Schurman; H. G. Scott; R. Y. Scott; V. Sefers; B. G. Sheridan; R. D. Shipton; M. H. C. Shiu; E. Shpiro; E. Silon; H. W. Silverstone; L. M. Simon; R. A. Simon; J. H. Simons; R. B. M. Smart; L. C. Smith; S. G. Smith; R. M. Smythe; G. R. Spencer; S. L. Sperber; J. A. Spotton; H. K. Stammer; G. M. Steiner; M. Stinnes; H. Suga; W. S. Szabo; A. S. Taylor; F. A. Taylor; G. Theberge; B. R. Thomas; M. Timascheff; A. J. Timleck; J. E. Tomlinson; E. A. Traynor; J. E. Udd; E. S. Uszkay; J. A. A. Vaillancourt; C. Vallerand; A. Varvaro; E. C. Venezian; M. Videtic; R. A. Wahlstrom; K. Waranica; R. O. Weir; D. E. Welch; H. A. T. Westman; J. F. Wickenden; B. J. Wiesenfeld; C. G. Williams; S. J. Windisch; D. A. Woodward; D. Zackon; B. J. Zaitlin; Z. P. Zollmann; P. J. A. Zsombor-Murray.

University of New Brunswick: R. S. Bagnall, G. L. Baker; R. J. Bell; J. R. Boissonnault; G. R. Burtt; J. R. Cushing; G. L. Gibson; A. D. Gray; L. C. Jenkinson; R. H. Kraft; G. J. J. Levesque; R. L. Mutch; I. R. G. Lowe; R. D. MacAndrew; A. E. MacDonald; C. McGraw; W. L. Mulherin; G. A. Oldham; J. H. Phillips; J. A. Saunders; D. L. Seheult; G. Singh; R. A. C. Staples; A. W. Tracey; A. Vennos; G. Vlahos.

University of Manitoba: H. S. Amos; F. W. Armstrong; G. C. Backman; C. D. Banks; B. A. Biglow; D. K. Biglow; L. G. Bosc; J. C. Bright; W. S. Brockowski; C. J. Brown; R. G. Brown; W. H. Butterfield; J. B. Campbell; D. L. Chinfen; J. A. Chute; M. H. Cooper; M. P. Czava; D. G. Dalrymple; C. B. Dawley; J. P. Dean; E. M. Elliott; J. E. Forrest; J. H. Forsyth; D. J. Fraser; T. C. Gardner; R. E. Gittins; D. L. Gushe; C. G. Hannah; W. A. Hansen; E. W. Heiman; B. W. Howard; J. G. Hutcheson; M. Ito; J. I. Johannson; D. F. Johnson; F. C. Johnson; B. K. Johnston; L. S. Jurewicz; R. M. Kirshner; S. Korbutiak; R. M. Korchynski; G. W. G. Krucik; R. C. Kruger; A. M. Lansdown; W. J. Lapchuk; D. J. Lee; A. L. Lobel.

A. E. Maes; G. E. Mainman; A. E. McBurney; A. J. McCabe; A. Melnick; M. J. Minor; D. W. Mitchell; M. E. Moffat; R. Molinski; R. S. Morrison; F. A. Mulligan; B. D. Norrie; D. Oleksink; L. H. Pakulak; J. Pascoe; A. F. Peirce; P. Penner; G. W. Philipps; C. M. Pratt; E. A. Pratt; T. B. Rea; K. J. Reinsch; A. R. Robertson; R. M. Ronald; B. J. Rossen; C. A. Roylance; L. D. Sanderson; D. A. Schick; W. E. Schmidt; N. Shapiro; D. H. Shearer; V. G. Shelton; W. Shulyk; O. T. Sigvaldason; S. E. Smendziuk; A. E. Smith; R. W. Solohub; J. N. Speirs; E. M. A. Stanik; T. M. Stefanson; J. M. Stephens; G. W. Stephanson; G. P. Stevens; A. G. Stevenson; G. B. Strange; G. G. Swan; C. V. Thio; D. G. Turner; H. J. Underhill; D. W. Whitmore; W. B. Wilson; M. Wityshin; W. N. Woods (Miss); G. K. Yuill; R. D. Zeidman.

Queen's University: D. R. Adams; A. Birkhans; A. G. Borud; J. E. H. Broughall; J. W. Carter; E. J. Coates; R. J. Collins; R. J. Conlon; D. W. Derrick; D. W. Devenny;; R. A. Edmunds; J. M. Epplett; R. E. K. Fiander; P. R. Fleet; M. B. Fraser; L. R. Hall; V. K. Handa; C. A. T. Harnden; W. C. Holman; R. P. Jarvis; C. C. Johnson; A. G. Kelly; W. E. Kelley; N. A. Klinger; C. D. Leavens; J. H. Leggett; T. J. Lee; A. J. Lynch; M. J. MacMaster; J. L. Malcolm; W. J. Menary; H. A. Meyer; M. Merko; J. R. Morgenroth; R. R. Moskalyk; D. Murphy; A. Pint; R. J. Poirier; C. F. Prong; J. D. Redfern; J. F. Robertson; L. C. Robertson; P. A. Smith; R. H. Smithson; L. J. Stone; J. B. Stroud; H. R. Whiteley; R. H. Wilkins; R. E. Woolcott.

Nova Scotia Technical College: A. A. Andrews; N. A. Barrett; D. R. Bewley; P. E. Chandler; D. S. Estey; W. M. Fluhmann; G. J. Frontain; M. C. H. Grant; C. D. Lethbridge; D. W. MacIntosh; E. Y. F. Mark; D. M. Margeson; W. Newman; D. H. Paterson; C. E. C. Semple; J. C. Sinclair; L. L. Wright; F. W. Young.

University of Alberta: D. G. Bacon; B. L. Bowsfield; H. T. Butchart; R. W. Culley; G. Eliasson; D. D. Farrell; J. B. Ferguson; E. P. Figol; A. E. Hanert; T. E. Kellen; S. Y. Lee; K. Lukawitsky; F. E. Magyar; G. A. Ross; G. N. Strynadka; J. R. vander Linden; R. Walker.

Acadia University: D. A. Allen; J. D. Cameron; L. R. Delaney; W. A. Gilroy; R. A. Harris; R. C. Knock; J. MacLennan;: T. S. Twells; J. K. Young.

Dalhousie University: W. D. C. Cook; J. W. Grennan; W. J. M. Meadus; N. E. Rudback; R. M. Soberman.

University of British Columbia: T. J. Babcock; G. van Dijk; L. R. Dilworth; C. A. C. Dobell; L. H. Hayton; J. L. Irvine; G. D. McLellan; H. R. T. Prudhomme; J. R. Soderberg; G. L. Stovel; A. F. Vanidour; G. H. von Dehn.

University of Toronto: T. A. Brzustowski.

Graduates: P. Moody, University of Toronto, 1957, B.A.Sc.(Civil); B. A. Oliver, University of Toronto, 1957, B.A.Sc.(Elec.).

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

SASKATCHEWAN

Members: J. J. Bakker; G. L. Haight; H. P. Harrison; C. J. Karasek; E. F. Mahaffy; N. W. Naimish; J. B. Renton; J. M. Schmidt; L. D. Sirett.

Juniors: M. Barabas; B. Jezzi; M. Kesmarky; D. C. Kesteven.

Student: R. J. Clarke.

Junior to Member: G. E. Baldwin; G. J. Goldsworthy; V. V. Neis.

NOVA SCOTIA

Junior to Member: J. P. Archibald; T. F. Clahane; J. D. Koppernaes; W. F. Mulhall.

NEW BRUNSWICK

Member: J. O. Dineen.

MANITOBA

Member: A. C. Warrender.

President C. M. Anson Continues His Tour of the Branches

A meeting of the policy committee in Montreal assembled (left to right) V. A. McKillop, R. L. Dunsmore, I. R. Tait, R. E. Heartz, Miss May McLaren, J. B. Stirling, D. M. Stephens, B. G. Ballard (back to camera), and A. Deschamps. ↓

At Saint John, N.B., a branch meeting marked Mr. Anson's visit. Head table guests included Mrs. Mitchell, H. W. M. Townshend, vice-chairman, Mrs. Doty, Mayor W. W. Macauley, Mrs. Donahue, Mr. Anson, J. J. Donahue, Mrs. Anson, Mayor Parker D. Mitchell of Lancaster, Mrs. Townshend, H. W. L. Doane, Mrs. Macauley, A. G. Watt and F. L. Doty.

Mr. Anson presented the E.I.C. tie clip to Life Member F. P. Vaughan (centre, right) while Vice-President H. W. L. Doane looked on. ↓

Other guests at the Saint John meetings were: L. O. Cass, Mrs. Cass, W. E. Seeley, Mrs. Sadler, R. F. Sadler, and A. E. Hanson; H. A. Whittaker, F. P. Vaughan, C. D. McAllister, Mrs. Chestnut, V. S. Chestnut, and D. M. Vye. ↑

↑ The president's visit to St. John's, Nfld., included meetings with the Branch executive, the members, and the students at Memorial University. At the University he talked with Dr. Gushue, president, (left), with H. W. L. Doane, V. A. Ainsworth, Branch chairman, F. Duffett, president of the Student Engineering Society, and Dean S. J. Carew.

The executive meeting in progress.

→

A group of members and guests at dinner meeting in St. John's: right to left, M. Doody, Pauline Morris, E. D. Manchul, Mrs. Manchul, Mrs. Cameron, M. Cameron, Mrs. Grant, F. Grant, Mrs. Myers and R. Myers.

At a dinner with the Halifax Branch: Mrs. Anson, the president, R. D. T. Wickwire, branch chairman, Mrs. Wickwire, I. P. Macnab, Mrs. Macnab, and J. B. Hayes.

Wickwire vs. Wickwire. Branch chairman R. D. T. Wickwire chats with L. D. Wickwire, president of A.P.E.N.S., at dinner honouring President Anson.

The Fredericton visit centered around the official opening of a new wing of the engineering building of University of New Brunswick.

The "student's table" at the branch meeting. J. Whiteley, D. Ballance, R. Lynch, M. Schofield, H. Eoekstel, J. Oudemans, A. White, S. Caughey, F. Christensen and E. Carpenter.

↑ At the head table, Mrs. E. O. Turner, Premier H. D. Flemming, Mrs. Anson, R. P. Lynch, branch chairman, President Anson, Mrs. Lynch, Dr. C. B. MacKay, president, U.N.B., and others.

↓ At another table, J. Murray, of the Alumni Association, Mrs. Weyman, C. E. Weyman, Mrs. Cuthbertson and W. B. Cuthbertson

← Students enjoy a brief chat with Mr. Anson in new lounge at U.N.B.

Dr. C. B. MacKay, U.N.B. president, Mr. Anson, and H. W. L. Doane.

W. D. G. Stratton, president of A.P.E.N.B., presented awards.

Presentation of student prize to H. N. Craig.

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Walter Henderson Shillinglaw, M.E.I.C., one of the few surviving charter members of the Institute died at the age of ninety-three at his home in Brandon, Man., on November 20, 1957. Mr. Shillinglaw was a member of The Institute for fifty years.

Mr. Shillinglaw was born at Staffa, Perth County, Ontario on September 29, 1864. He attended schools in Albany, Mo., U.S.A and at Portage La Prairie and Brandon before enrolling at the University of Manitoba from which he graduated in 1886. He attended the University of Toronto School of Practical Science from 1886 to 1889, assuming private practice shortly thereafter as an architect. In 1896 he took on the additional work of city engineer. for the city of Brandon, Man. devoting himself for many years to city work. He was also responsible for the original dam on the Little Saskatchewan River.

Mr. Shillinglaw joined the Institute as a Student member in 1887; became an Associate member in 1900; and a member in 1908. He attained Life Membership in 1931.

W. H. Shillinglaw, M.E.I.C.

J. G. G. Kerry, HON. M.E.I.C., retired consulting engineer, died in his ninety-first year on November 14, 1957, at Port Hope, Ont.

Mr. Kerry was born at Montreal on August 9, 1867. Educated at McGill University, he graduated with honours with a B.A.Sc. degree in civil engineering in 1886. Following graduation Mr. Kerry spent several years in railway survey work both in Canada and the United States. He returned to Canada in 1892 in order to qualify for an M.Eng. degree at his alma mater. Subsequently he joined the teaching staff of the faculty of applied science at McGill. He remained there until 1907. Meanwhile, in 1898 Mr. Kerry had become a partner in the firm of Smith, Kerry and Chace, consulting engineers, later known as Kerry and Chace Limited. He remained a part of the company until his retirement in 1939. During a great part of his career, from 1907 until 1932 he was associated with the Temiskaming and Northern Ontario Railway as consulting engineer.

Mr. Kerry was for many years active in the construction and operation of power plants and paper mills. Construction work for which he was responsible included hydro-electric power plants, for the Nipissing Power Company, Seymour Power and Electric Company, Canada Cement Company and Hollinger Gold Mines. He was concerned with paper mill construction including plants for the Northumberland Paper and Electric Company and the Canadian Paperboard Company. Largely concerned with the pulp paper and power fields Mr. Kerry was before his retirement in 1939 elected president of Northumberland Paper and Electric Company, Seymour Electric Power Company and associated companies, the Canadian Paperboard Company and the Quinte and Trent Valley Power Company. He was also secretary of Boundary Investments Limited.

In 1946 Mr. Kerry was awarded the Gzowski Medal of the Engineering Institute, given for the best paper of the year on any subject. The winning paper was entitled, "The Winter Temperature Cycle of the St. Lawrence Waters."

Mr. Kerry was known as a teacher and consulting engineer and served his profession for more than sixty-five years.

In 1887, the year of its founding, Mr. Kerry joined the Engineering Institute as a Student member. Transferred to Associate membership in 1894, he became a full Member in 1904. He attained Life membership in 1938, and was awarded Honorary membership in 1952.

J. G. G. Kerry, HON., M.E.I.C.

His contributions to the professional life of the Institute were considered great. The Port Hope Branch of the Institute recognized this contribution in appointing him Honorary chairman on its inauguration in 1952.

James Morrow Oxley, M.E.I.C., retired architect and engineer of the firm of Chapman and Oxley, Toronto, died in that city on October 8, 1957.

James Oxley was born on September 12, 1883, at Halifax. In 1904 he enrolled at the University of Toronto where he studied applied science. Assistant engineer on construction with the Aberdeen Elevator Company, Midland, Ont., in 1905 he also worked for a short time with Canada Foundry Company before entering a partnership under the name of Oxley and Chadwick, structural designers, in Toronto, in 1907. Two years later he was named chief engineer to McGregor and McIntyre Limited, structural steel works, also in Toronto. The firm of Harkness and Oxley, consulting engineers to architects on structural design came into being in 1911. It was responsible for the John Inglis Boiler Shops; the J. F. Brown Copper and Brass Rolling Mills; the C.P.R. Building; the Dominion Bank building; the Methodist Book and Publishing House; Knox College, the R. S. Williams Building; the Veterinary College and many others.

Operations of the firm were interrupted by World War I. Mr. Oxley served overseas with the Canadian Expeditionary Force, 95th and 124th battalion, 1915-1919, attained the rank of major, and finally transferred to the 12th battalion Canadian Engineers.

Returning to this country in 1919 he became a member of the firm of Chapman, Oxley and Bishop, architects and engineers, Toronto, which association was continued throughout his entire career. Mr. Oxley was also known for his part in the design of the Royal Ontario Museum, Sunnyside amusement park, the Princes' Gates, a number of C.N.E. buildings, the new Bank of Montreal building, the Star building, Sterling tower, the National and Northern Ontario buildings and Holy Blossom Temple.

Mr. Oxley served on the National Building Code committee from 1939 to 1941.

In World War II he designed war plants for Central Aircraft and Toronto Arsenals.

Mr. Oxley was named a Fellow of the Royal Architectural Institute of Canada in 1950.

A Life member of the Institute since 1947, Mr. Oxley joined the Institute as a Student member in 1901; transferred to Associate Member in 1908. He became a Member in 1921.

Roy Talmage Steeves, M.E.I.C., architect and engineer of Fredericton, N.B., for seventeen years a member of the faculty of applied science at Acadia University died in that city on November 28, 1957.

Roy Talmage Steeves was born at Moncton, N.B. on January 17, 1897. He attended Moncton High School, New Brunswick Normal School, and served for three and a half years overseas with the Canadian Army, winning the Military Medal for bravery, before engaging in further studies. Awarded a B.A. degree in 1927 from Acadia University, he received the further qualifications of an engineering diploma and an M.Sc. degree in 1929 from that seat of learning. He also studied at the Massachusetts Institute of Technology for one year and undertook research in engineering and architecture at the Georgia Institute of Technology. Named an instructor in engineering at Acadia University in 1927 he was promoted to assistant professorship in 1933, becoming associate professor two years later. Achieving the status of a professor in 1937, his services to the university were for a time interrupted by a term of service with the R.C.A.F. As a technical officer during World War II, he saw service at No. 1 Wireless School, Montreal and as a ground instructor at Chatham, N.B. air-base. He later returned to New Brunswick as an architect and engineer for the Department of Education and introduced a school-building program. These schools are now in operation throughout the province. Due to ill-health Mr. Steeves was obliged to retire from professional endeavors in 1956.

Mr. Steeves joined the Institute as a Member in 1946.

G. Murdoch, M.E.I.C., retired consulting engineer of the St. John, N.B., firm of Murdoch-Lingley Limited died on June 29, 1957 at Saint John.

Gilbert Gray Murdoch was born in that maritime centre on October 13, 1876 and educated there. His engineering education was conducted under private tuition in the office of his father, then engineer and superintendent of water and sewage for the City of Saint John.

Obtaining a certificate early in his career as a deputy land surveyor for New Brunswick, he established himself in private practice at Saint John as early as 1895, specializing in municipal engineering.

Notable in his career, among other things is his connection with the construction of most of the water works and sewage systems in that province. He also designed and constructed many hydraulic structures for the New Brunswick Power Company. He was instrumental in the development of the Saint John Airport.

Mr. Murdoch retired from active consulting practice in 1953.

One of the incorporators in the Association of Professional Engineers of New Brunswick, he subsequently became president of the organization. He was a member of the Dominion Council from its inception in 1933, serving as one of the three representatives of the New Brunswick Association.

Mr. Murdoch was one of the wardens of Camp 9 of the Corporation of the Seven Wardens.

Active in the affairs of the Engineering Institute of Canada, he was one of the early chairmen of the Saint John Branch. He served as a councillor in 1925; and as a vice-president representing the maritime provinces in 1942-43.

Elected Life member of the Institute in 1947, Mr. Murdoch joined the organization as Student Member in 1905, transferred to Associate Member in 1911 and to Member in 1919.

Merle Franklin Ker, M.E.I.C., for thirty-five years engineer for Stamford Township, Ontario, died at Niagara Falls, Ont., on November 18, 1957.

Born there on May 23, 1894, Mr. Ker followed engineering studies at Queen's University, graduating with a B.Sc. in 1918. His studies interrupted by World War I, he served as a bombardier in the Canadian Artillery. While a student employed with the City of Niagara Falls, engineering department, and with the Hydro-Electric Power Commission of Ontario he went immediately to the staff of the latter organization on graduation, working in the laboratory department on field drafting and inspection. Mr. Ker was employed on the Sir Adam Beck No. 1 Queenston Hydro power project before his appointment as Stamford Township engineer. In 1921 he took over responsibility for all construction for the township of Stamford. He took charge not only of construction for Stamford township but also the design of waterworks, sewers and roads.

He joined the Institute as Junior Member in 1920, transferred to Associate Member in 1927 and became a Member in 1940.

Robert West Moffatt, M.E.I.C., retired professor of civil engineering, University of Manitoba, died at Selkirk, Man., on December 4, 1957.

Mr. Moffatt was born at Bognar, Ont., on September 28, 1875. After a short period spent as a school-teacher in Western Canada, Mr. Moffatt went on to further studies at the University of Toronto, school of practical science, and graduated with a B.A.Sc. degree in 1905. A short period of experience with the Canadian Westinghouse Company Limited, at Hamilton, Ontario, and with the firm of Smith, Kerry and Chace, Toronto, followed his graduation. He was also engaged as a demonstrator in civil engineering at the University of Toronto and as an instructor at the Ontario Agricultural College for several years. In 1912 Mr. Moffatt was appointed to the staff of the University of Manitoba as an instructor in civil engineering. He retired in 1944.

Mr. Moffatt joined the Institute as a Student Member in 1910; became an Associate Member in 1913 and transferred to Member in 1940. He attained Life Membership in 1946.

Review of U.S. Education Practice

An important report of United States practice in engineering education and training is available through the Engineers' Council for Professional Development. (29 West 39th St., New York 18, N.Y.)

It is a 64-page, paper bound and graphically illustrated report, containing the contributions of ECPD, the American representative to the Third Conference of Engineering Societies of Western Europe and the United States of America (EUSEC), which was held in September, 1957, in Paris. The cost of a copy of this report is $5.00.

ECPD's contribution, therefore, covering the seven subjects listed below, offers a current and comprehensive factual report of educational practice in the United States.

The seven subjects are:

1. Glossary. Including a description of the educational system, diagrams showing different routes through engineering and technological education, and a definition of terms used in education.
2. General education before, and selection for, admission to engineering schools of university level.
3. Selection for admission to engineering school.
4. Education at engineering schools of university level.
5. Practical training, before, during, and after engineering studies.
6. Criteria for professional status.
7. Post first degree education.

NEWS OF THE Associations and Corporation

Information received through co-operation of the provincial organizations.

ONTARIO

Elections for 1958

The 16,000-member Association of Professional Engineers of Ontario, on January 3, 1958 elected Charles Terry Carson of Windsor, Ont., as its 1958 president. He succeeds John H. Fox of Toronto as head of the largest professional organization of its kind in Canada.

In business life, Mr. Carson is vice-president and production manager of Hiram Walker & Sons Ltd., Walkerville, Ont. He is also chairman of the committee on engineering education at Assumption University, Windsor. The university's branch, Essex College, offers degree courses in four branches of engineering — chemical, electrical, civil, and mechanical.

Carson, a member of the Association since 1946, has served on the executive council for five years, and last year was the Association's first vice president. He is a graduate of the University of Toronto, and is also a Fellow of the Chemical Institute of Canada.

Elected first vice-president for 1958 is Andrew F. McQueen, Niagara Falls, Ont., who is president of H. G. Acres & Co. Ltd. Second vice-president is Gordon M. McHenry, London, Ont., consumer service engineer for the Ontario Hydro, London region.

Also elected were the following councillors, two for each branch, in addition to one from each branch being appointed by the Lieutenant-Governor-in-Council.

Civil branch: Tullis N. Carter, Toronto, vice president and general manager, Carter Construction Co. Ltd., and Robert A. Weir, civil engineer employed by the Ontario Department of Lands & Forests. The appointed representative is V. S. Murray, Toronto.

Chemical and metallurgical branch: Patrick E. Cavanagh, Toronto, director of engineering and metallurgy, Ontario Research Foundation, and Edmund P. Lewis, Sarnia, senior chemical engineer, Polymer Corporation Ltd. The appointee is D. S. Simmons of Toronto.

Electrical Branch: Robert L. Hicks, Toronto, engineer, distribution planning and design department, Toronto Hydro-Electric System; and John W. Holmes, Peterborough, design engineer, Canadian General Electric Company Limited. The appointee is J. Herbert Smith, Toronto, president of Canadian General Electric Company Limited.

Mechanical, aeronautical and industrial branch: Donald L. Angus of H. H. Angus & Associates Ltd., Toronto, and Lawrence C. Sentance, Hamilton, manager of the defence apparatus division, Canadian Westinghouse Co. Ltd. The appointee is Dr. G. Ross Lord, head of the mechanical engineering department, University of Toronto.

Mining branch: Marc Boyer, Ottawa, deputy minister of the Dept. of Mines & Technical Surveys; and Martin L. Urquhart, general manager, McIntyre Porcupine Mines Limited, Toronto. The appointee is Dr. G. B. Langford, Toronto, head of the department of geological sciences, University of Toronto.

Engineers in the News

E. Bonar Lindsay, P.ENG., who has been an associate of J. Edgar Dion, P.Eng., management consultant engineer in Montreal, informs us that the firm has been incorporated under the name of J. Edgar Dion & Company Ltd. Offices are located at 4643 Sherbrooke St. West, Montreal.

W. A. Martin, P.ENG., has moved from Preville, Que., to Ottawa. He has joined the Board of Transport Commissioners of Canada as senior supervisor of explosives and other hazardous materials. Mr. Martin graduated in engineering from the University of Alberta in 1947 and for the past ten years has been employed by Canadian Industries Ltd.

F. M. Schwieder, P.ENG., of Colgate-Palmolive Ltd., who has been in Switzerland for some time, has returned to Canada and is with the company at 64 Colgate Ave., Toronto.

Peter S. White, P.ENG., is now with Texas Gulf Sulphur, 170 University Ave., Toronto.

William E. Sheresky, P.ENG., has left the British American Oil Co. Ltd., with which he was employed in Toronto, and is now with Hinde & Dauch Paper Co. of Canada Ltd. in Trenton, Ont.

J. B. Harper, P.ENG., formerly a salesman with the Honeywell Controls Ltd., industrial division in the Hamilton office, has been appointed branch manager of the company's Sudbury office. Mr. Harper graduated in engineering from Queen's University, Kingston in 1954 and immediately joined the Honeywell organization.

Robert W. Higgs, P.ENG., of the Public Works Department of Canada, Ottawa, has been awarded the 1957 International Road Federation Scholarship by the scholarship committee of the Canadian Good Roads Association. A graduate in civil engineering from Queen's University in 1949. Mr. Higgs has been with the Trans-Canada Highway Division of Public Works. He will take a post-graduate course in regional planning at Cornell University.

J. Szymanowski, P.ENG., of Dominion Electric Manufacturing Co. Ltd., Toronto, has been promoted to chief engineer. The company produces high and low tension electrical distribution equipment, switchboards and similar equipment. He joined the Dominion Electric Manufacturing Company a little over five years ago.

I. C. Igimundson, P.ENG., holds the post of executive assistant with Hydro-Electric Power Commission of Ontario, administration branch. Prior to this change he was administration and service engineer in the frequency standardization division.

G. Frank Jannaway, P.ENG., of the St. Catharines Public Utilities Commission, St. Catharines, Ont., has been appointed assistant manager. Mr. Jannaway graduated from the University of Toronto in 1948 and joined the St. Catharines P.U.C. in 1950.

C. R. Stones, P.ENG., has accepted a position as chief engineer, paper division, with Price Brothers Co. Ltd., Kenogami, Que. Before joining this organization he was on the engineering staff of The Bowater Corporation of North America Ltd., in Montreal.

Kenneth J. Sewrey, P.ENG., is process engineer in the acrylic fibre section of the Maitland Works, DuPont Co. of Canada (1956) Ltd., in Maitland, Ont. He was previously with the Spruce Falls Pulp & Paper Co. Ltd. in Kapuskasing, Ont.

J. H. Stevens, P.ENG., of the Canada Wire & Cable Co. Ltd., Leaside, To-

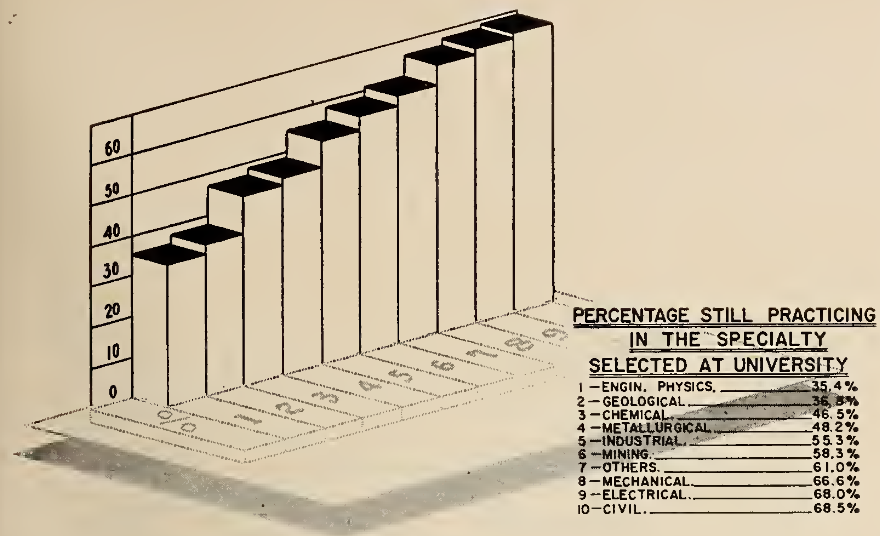


Table 1

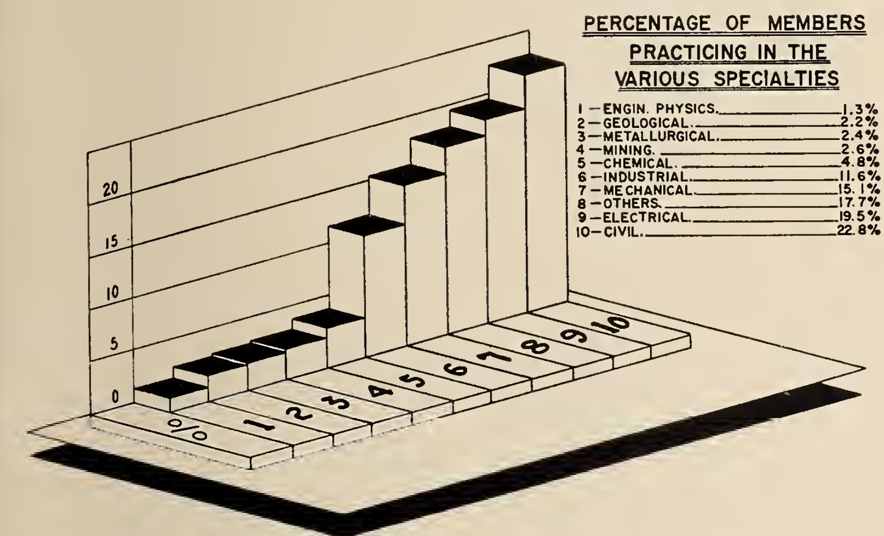


Table 2

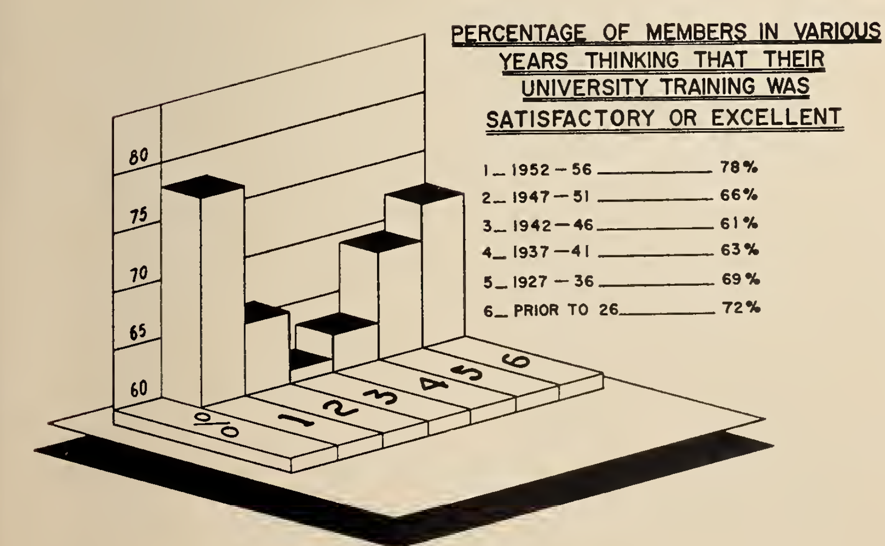


Table 3

ronto, has been appointed manager of general plant planning and engineering. Mr. Stevens graduated in mechanical engineering from Cambridge University in 1938. Ten years ago he joined Canada Wire & Cable Company.

QUEBEC

Quebec Engineers Well Pleased with Training Provided by Universities

During the course of last year, the Corporation's committee on professional training initiated a survey among engineers, employers and universities in order to find out to what extent university training fulfills the needs of the profession in private practice and industry. About one-third of the members of the Corporation have answered the questionnaire prepared for them by the committee members; questionnaires for employers are currently being prepared.

Results of the survey among engineers offer interesting information for all members of the profession, but especially for the directors of our engineering schools and universitics, because they constitute an expression of opinion that may be a useful guide in the elaboration of programs and the preparation of courses.

For many years, the deans or directors of engineering schools have discussed the relative advantages of basic general training and of strict specialization. Table 1, showing the percentage of those actually practising in the specialty they have selected at University throws additional light on the subject. Considering that some 50 per ccnt of the answers originated from graduates of the last ten years, one must expect that others will change their field of practice.

Table 2 represents the proportion of members actually practising in each of the ten specialties listed in the questionnaire. It will be seen that the greatest number of engineers are in civil engineering, and that electrical engineering occupies second place. Third, we find all other specialties not specified (aeronautical, petroleum, industrial testing, valuation, etc.) which illustrates the diversity of positions filled by engineers.

We are pleased to find that the percentage of those who have found the technical training received at the university either "satisfactory" or "excellent" —as illustrated in Table 3—increases with the more recent years of graduation. Exception must be made for the very early years of graduation, where technical knowledge has become less indispensable as the engineers involved moved towards higher administrative positions.

Answers to the questionnaire, compiled mechanically, offer numerous details which are not necessarily of general interest, but could be considered in the study of programs and the content of courses. Using the code number assigned to each university, one can find the opinion of five or ten graduating classes on the principal subjects of the curriculum. Although this may terminate examination of the situation from the point of view of our general membership, we are sure that it will initiate critical review at the university level. The Corporation of Professional Engineers of Quebec will be pleased to cooperate fully with the university representatives on this matter.

1958 Annual Meeting

The 1958 General Annual Meeting, to be held at the Sheraton-Mount-Royal Hotel in Montreal on Saturday, March 22, will be highlighted, as have been past annual meetings of the Corporation, by an Art Exhibition. The 1958 exhibition will show paintings, sculpture and ceramics by members of the Corporation.

Northern Electric Largest Employer

At year end, Northern Electric Company Limited ranked first among the larger employers of Quebec engineers; it had 273 professional engineers on its staff, an increase of 64 over last year. Bell Telephone Company which was first last year, is now in second place. Follows a list of the 27 larger employers of Quebec engineers and the number of persons authorized to practise engineering in each. Last year's figures appear in parentheses; (x) means less than 38.

Northern Electric	273	(209)
Bell Telephone	251	(244)
City of Montreal	228	(219)
Aluminum Co. of Canada	194	(172)
Hydro-Québec	157	(144)
Quebec Roads Dept.	105	(105)
Dominion Bridge	100	(78)
Shawinigan Water & Power	86	(79)
Canadair	85	(60)
Canadian Industries Ltd.	77	(64)
C.N.R.	68	(58)
Canadian General Electric	61	(58)
Consolidated Paper	60	(51)
Canadian International Paper	59	(52)
Dominion Engineering	59	(44)
Shawinigan Engineering	55	(51)
Montreal Engineering	53	(x)
Canadian Pacific Railways	51	(54)
St. Lawrence Seaway	48	(x)
R.C.A. Victor	48	(42)
Imperial Oil	46	(x)
Ecole Polytechnique	46	(x)
McGill University	45	(44)
Dupont	42	(x)
Quebec Public Works	39	(38)

MANITOBA

(Taken from "A Message from The President," by N. S. Bubbis, published in The Manitoba Professional Engineer, December 1957 isue)

President's Message

All of last year's committees were reappointed and have actively pursued their tasks. In addition the following new committees were established and have been working hard: plan for unity committee; certification of technicans committee; and a professional ethics committee. A special committee assisted Council with a brief submitted to the Royal Commission on Flood Cost Benefit, a joint standing committee of the Manitoba Association of architects and our Association has been set up. Another committee under the chairmanship of T. E. Storey, P.Eng., has been reviewing the Association's constitution and bylaws to determine whether any changes are required.

Another innovation this year was the meeting of Council members with engineers in Northern Manitoba held recently in Flin Flon. This was a most successful venture and is further evidence of the changes that are being brought about by the development of our Province.

Council this year also decided to establish a closer liaison with engineering students at the University and with new graduates. Early this year a letter was sent to every graduate, inviting him to join the Association as an engineer in training. This was followed by a personal appeal by the president at the Kipling Ritual. Recently a meeting with the third and fourth year engineering students, which we will hope is to become an annual event, was held at the University under the chairmanship of Dean A. E. MacDonald, P.Eng. The association of Professional Engineers of Manitoba was represented by Dr. Landon, P.Eng., chairman of the public relations committee, and President Bubbis. The objectives of the Association were outlined to the students and they were invited to become student members. The meeting was well-attended and the numerous questions which followed indicated the keen student interest. A considerable number of applications for both engineers in training and engineering pupils have since been received.

BRITISH COLUMBIA

Annual Meeting Held December 13-14

The two-day annual meeting of the Association of Professional Engineers of B.C. held December 13-14, at Vancouver, was climaxed with the decision to proceed with the purchase of a new headquarters building at a cost of approximately $90,000. It is the Baynes-Manning Construction Company office at 2210 West 12th Avenue in Vancouver.

About three years old, the building offers double the area of present Association headquarters at 1166 West Pender Street. Registrar J. A. Merchant, P.Eng., stated that the purchase would probably be completed by February.

New officers elected for the coming year were headed by mining engineer G. C. Lipsey, former vice-president and general manager of Britannia Mining & Smelting Co. Ltd., Britannia Beach. In a short address in which he accepted the office from retiring President W. O. Richmond, Mr. Lipsey announced his intention to take a year off from work and devote his full time to the Association's affairs. It will be the first time since the Association's formation in 1920 that it has been served in this way.

Other officers elected were Vice-President R. E. Wilkins, and Councillors F. A. Lazenby, F. Noakes, H. P. J. Moorhead, B. O. Brynelsen, all of Vancouver, and B. P. Sutherland, Trail, B.C.

Professor Richmond, as past president, remains on the Association Council for the coming year. The other four members of the 12-man Council will be appointed by the provincial government in the near future.

In his report on the year's activities, President Richmond drew attention to the fact that there had been, for the second consecutive year, a 20% increase in the number of membership applications received.

L. H. Cook, P. Eng., chairman of the Salary Committee, reported that a new schedule of salaries had been drawn up calling for upward revisions. This was recommended because the starting salaries of newly graduated engineers were falling behind the rising level of artisans' wages. The new scale recommends increases of approximately 11 per cent. Acceptance of the new scale has been received from the Canadian Council of Professional Engineers, who noted that by coincidence the B.C. report was almost identical to one presented at the same time by the Ontario Association.

The meeting also heard reports on the progress of the Canadian Council of Professional Engineers' committee on Confederation with the Engineering Institute of Canada and was advised that the annual meeting of the Canadian Council would be held in Vancouver May 7-9 at the Hotel Georgia. It was stated the national body expects shortly to open a full time office at Ottawa.

Hearty support was given to a public relations committee recommendation that the Association implement a plan for closer liaison with members of the high school teaching profession instructing science courses.

B.C. Minister of Industrial Development, Trade and Industry, R. W. Bonner, speaking at the Association luncheon, reported on his recent trip to Europe. He stressed the future importance of Europe as a market for B.C. and Canadian goods. With the establishment of the European common market a free trade area with a consuming population larger than the United States would be created. It would be folly not to make maximum efforts to do business with them, he noted.

Life membership medals were presented to six members. Another eight to be so honoured were unable to attend.

Announcement was made at the luncheon of the winners of a number of scholarships and book prizes.

Personals

News of the Personal Activities of Members of the Institute

Denton Massey, M.E.I.C., (B.Sc., general engineering, M.I.T., 1924), general manager of AMF Atomics (Canada) Limited, since 1956, has been elected a vice-president and director and will continue as a general manager. Mr. Massey started his business career with Massey-Harris Company Limited, working up to the position of manager of the Toronto Works. He entered public life in 1935 as a member of the Canadian Parliament, and was elected for three consecutive terms.

In recent years Mr. Massey has won recognition as an outstanding speaker on the peaceful uses of atomic energy.

Gordon B. Tebo, M.E.I.C., (B.A.Sc., elec., Toronto, 1929), has accepted an appointment with the Canadian Standards Association Testing Laboratories as manager of the laboratories. He was elected to the board of directors, C.S.A., in 1955.

Mr. Tebo's career has been linked with the Hydro-Electric Commission of Ontario for many years. He was named director of research in the latter organization in 1953. Lately he has served as director of employee relations and also as director of the organization services division.

Ignace Brouillet, M.E.I.C., (B.A.Sc., C.E., Ecole Polytechnique, 1929; D.Sc. (Hon.) Laval, 1950), of the firm of Brouillet and Carmel, consulting engineers, of Montreal, has been named a director of the Provincial Bank of Canada following recent elections.

Louis Trudel, M.E.I.C., (B.A.Sc., civil, Ecole Polytechnique, 1936) manager of the public relations and advertising department of Shawinigan Water and Power Company, Montreal, has gone to Paris to attend the Quebec in Paris Exhibition, which opened January 17, closes February 28. In so doing, Mr. Trudel, onetime assistant general secretary of the Engineering Institute represents the Shawinigan Companies. Mr. Trudel was in 1955 elected president of the Montreal Branch of the Canadian Public Relations Society.

F. W. Bradshaw, M.E.I.C., (B.Sc., chemical, McGill, 1925), a member of the staff of Consolidated Paper Corporation Limited for twenty-three years, has been elected vice-president and executive assistant to the president, following a re-

Denton Massey, M.E.I.C.

cent meeting of the directors of the organization.

Mr. Bradshaw also holds office on the executive council of the Canadian Chamber of Commerce and on the Economic Development and Labour Relations Committees.

He is a past-chairman of the St. Maurice Valley Branch of the E.I.C., past councillor and chairman of the nominations committee.

He is a graduate of the Harvard Advanced Management Program.

W. J. LeClair, M.E.I.C., secretary-manager of the Canadian Lumbermen's Association has retired after twenty-two years' service with the association. In 1957 he took over the general managership of the organization.

J. R. von Renteln, M.E.I.C.

Mr. LeClair has set up a private practice as an industry consultant in Ottawa, crowning forty-six years' experience in logging, sawmilling, forest products research and marketing. His career has included 9 years practical experience in the United Kingdom, a two year period on the Continent and familiarity with Soviet and Scandinavian techniques in these fields.

Mr. LeClair was also managing editor of the publication, "Timber in Canada."

John R. von Renteln, M.E.I.C., (diploma, civil, Karlsruhe, 1927), has resigned as project engineer for the City of Kingston to act as general manager of the Overseas Instruments of Canada. He founded this firm in 1953 as sole owner for importing hydrometric, mathematical and other engineering equipment and lately established a branch in the United States.

Dr. I. R. Tait, M.E.I.C., consulting engineer at Montreal, with Canadian Industries Limited, past vice-president of the Engineering Institute of Canada, 1952-53, was named to the Council of the City of Montreal in October 1957. Appointed to office by McGill University, he represents the latter institution for 1958, 1959 and 1960.

P. L. Kuhring, M.E.I.C., of the St. Lawrence Ship Channel branch of the Department of Transport, named chief engineer in 1956, has retired after forty-five years of service.

Mr. Kuhring joined the Department of Public Works in 1913 in New Brunswick. In the following year he entered the then Department of Marine and remained with the chief engineer's branch until 1920 when he was transferred to the St. Lawrence Ship Channel. In 1944 he was appointed assistant chief engineer.

D. D. Dick, M.E.I.C., (B.Sc., civil, Alta., 1949), formerly chief civil engineer of the Power Corporation of Canada, Limited, has been appointed vice-president and general manager of Power Corporation Designers and Consultants Limited, Montreal. In his career to date Mr. Dick has been associated with the pulp and paper industry and power projects in the design, construction and maintenance of pulp and paper mills and power projects.

Power Corporation Designers and Con-

• PERSONALS

sultants Limited provides a complete engineering design and consulting service in the field of industrial and process plants, hydro-electric and steam power stations, pulp and paper mills and water treatment and sewage disposal installations.

C. R. Stones, M.E.I.C., (engineering economics, Bolton Municipal Technical College, 1929), has transferred his services from The Bowater Corporation of North America Limited, Montreal, to Price Brothers Company Limited, Kenogami, Que., where he will carry out the duties of chief engineer for the firm. Mr. Stones' association with The Bowater Corporation wa that of assistant to the manager of the engineering department.

O. J. Frisken, M.E.I.C., (B.Sc., mech., Queen's, 1929), of the De Laval Company has been appointed vice-president in charge of manufacturing. He is a director of the company and was formerly manager of manufacturing. He has been associated with the organization since 1936.

J. H. Legate, M.E.I.C., (B.A.Sc., Toronto, 1921), plant manager of the Canada Cement Company, plant No. 5, Belleville, Ont., has retired after an association of thirty-seven years in the cement

D. D. Dick, M.E.I.C.

manufacturing business. Mr. Legate became plant manager four years ago following many years as superintendent of the St. Anne plant.

Brigadier H. L. Meuser, M.E.I.C., (R.M.C., 1934; B.Sc., civil, Queen's, 1935), commander of the Northwest Highway System, Whitehorse, Y.T. since 1955, is now located at Army Headquarters, Ottawa.

E. E. Orlando, M.E.I.C., (B.Sc., elec., N.S.T.C., 1927), of Canadian Westinghouse Company Limited, Hamilton, Ont., has been named to the post of vice-president, apparatus and industrial sales. Mr. Orlando was formerly vice-president and general manager for the company's district apparatus division.

John W. Tomlinson, M.E.I.C., (B.Sc., elec., Manitoba, 1930), vice-president of the Northern Ontario Natural Gas Company Limited, Toronto, since 1956, and the Twin City Gas Limited has resigned to devote his full time to a consulting service. Mr. Tomlinson has had twenty-five years practical experience in Canadian electrical and natural gas utility engineering and management. He became assistant sales manager of Trans-Canada Pipe Lines Limited, Calgary,

E. C. Little, M.E.I.C.

Jean-Paul Drolet, M.E.I.C.

with offices in Toronto, in 1955 after a number of years experience with the Saskatchewan Power Corporation. As general manager of the Corporation he introduced natural gas to cities, towns and villages in Saskatchewan.

Jean-Paul Drolet, M.E.I.C., (B.A.Sc., mining, Laval, 1942; M.Sc., Columbia, 1947), of the Quebec Cartier Mining Company, Montreal, has received the appointment of assistant to the president. Mr. Drolet who was formerly with the Quebec Department of Mines, joined the Quebec Cartier Mining Company in 1956 as a mining engineer.

E. C. Little, M.E.I.C., (B.Sc., civil, McGill, 1915), of Fonthill, Ont., has been elected chairman of the Niagara Peninsula Branch of the Engineering Institute. A retired engineer, formerly with the Canals Branch, Ottawa, where he was engineer in charge of maintenance and operation, Mr. Little now engages in consulting engineering work and serves as engineer for the village of Fonthill.

H. W. M. Townshend, M.E.I.C., (B.Sc., marine, Durham, England, 1939), has been elected chairman of the Saint John Branch of the Institute. Mr. Townshend came to Canada in 1941. He is employed with the Saint John Dry Dock Company Limited, East Saint John, N.B.

H. W. M. Townshend, M.E.I.C.

C. G. Kemp, M.E.I.C., (mech., Technical College, Sydney, Australia, 1913), works manager with Consumers Glass Company Limited, since 1951, was recently elected a vice-president of operations for the firm. Mr. Kemp joined the company in 1934.

G. M. Dick, M.E.I.C., (B.Sc., mech., McGill, 1924), a vice-president of the Engineering Institute, residing at Sherbrooke, Que., has been named president of the St. Francis River Valley of the McGill Graduates Society. Mr. Dick is chief engineer of Canadian Ingersoll-Rand Company Limited at Sherbrooke.

W. F. Sharon, M.E.I.C., (B.Sc., civil, Queen's, 1939), has transferred his services from the Toronto firm of Sparling Tank Limited to the Mannix Company Limited at Calgary. His new post is that of executive vice-president. Mr. Sharon held the appointment of vice-president and general manager with the Sparling organization.

Roger Labonté, JR.E.I.C., (B.A.Sc., civil, Ecole Polytechnique, 1955), has since September 1957 and his return to Canada from studies in Great Britain held an assistant professorship on the staff of Ecole Polytechnique, Montreal. Mr.

Labonté was awarded an Athlone Fellowship in 1955. While in Britain, he was enrolled in a public health engineering course at Imperial College of Science and Technology in London. Mr. Labonté spent his second year with the firm of Sandford Fawcett and Partners, London, a firm of sanitary engineers with branches in Canada, known as Canadian British Consulting Engineers.

T. Argyropoulos, Jr.E.I.C., (B.Eng., mech., McGill, 1951), has left Montreal in order to accept a position in Bedford, Ohio, U.S.A. Formerly with Canadair Limited he is now associated with the firm of Pescoe Products.

J. D. Lamb, Jr.E.I.C., (B.A.Sc., mech., U.B.C., 1950), has received the appointment of sales manager of the Canadian division of the Wheelabrator Corporation, located at Toronto.

J. J. Paré, Jr.E.I.C., (B.A.Sc., civil, Laval, 1955), an Athlone Fellowship winner has returned to Canada as a soils engineer with the Department of Highways, Province of Quebec, at Quebec City. While on Fellowship Mr. Paré was enrolled at the Imperial College of Science and Technology, London, Eng., as a post-graduate student of concrete technology and soil mechanics. Mr. Paré, who qualified for the diploma of the Imperial College, (D.I.C.), states that he was afforded the excellent opportunity of study with Professor Skempton, president of the International Society of Soil Mechanics and Engineering Foundation.

W. H. Potts, Jr.E.I.C., (B.Sc., civil, Queen's, 1948), formerly with the Toronto firm of Guildwood Development Limited, has accepted an appointment as project engineer with Proctor and Redfern, consulting engineers, also of Toronto.

W. E. van Steenburgh, Jr.E.I.C., (B.Sc., elec., Queen's, 1948), has changed his address from Belleville, Ont., to Ottawa. Formerly with the Ontario Hydro-Electric Commission his professional association in Ottawa is with the Organization and Methods Service.

J. T. Denley, Jr.E.I.C., (B.Sc., Alberta, 1949), is now employed as a chemical engineer by the Elk Falls Company Limited, Campbell River, B.C. He previously served H. A. Simmons Limited, consulting engineers of Vancouver, as a design engineer.

Roch Boisvert, Jr.E.I.C., (B.A.Sc., elec., Laval, 1948), has been elected chairman of the Saguenay Branch of the Engineering Institute.

A native of Thetford Mines, Que., Mr.

Roch Boisvert, Jr.E.I.C.

Boisvert has been employed with the Saguenay Electric Company at Chicoutimi, Que., as an electrical engineer since his graduation. He became a district superintendent of the company in 1950, gaining the promotion of general lines superintendent early in 1957.

G. M. Ross, Jr.E.I.C., (B.Eng., elec., McGill, 1955), who won an Athlone Fellowship in 1955 has returned to Canada. He is employed with the microwave engineering group of Standard Telephones and Cables Manufacturing Com-

• **PERSONALS**

pany (Canada) Limited, Montreal.

In England Mr. Ross was associated with Standard Telephones and Cables, Limited, in London. During this time he was able to gain experience in many branches of the telecommunications industry.

Bruce W. Brunton, JR.E.I.C., (B.Sc., civil, Manitoba, 1953) has severed his connections with the Toronto firm of Town Planning Consultants Limited, and has accepted the appointment of City Engineer for the City of Owen Sound, Ont.

L. Grant Boundy, JR.E.I.C., (B.Sc., elec., New Brunswick, 1955), of the Canadian General Electric Company Limited has been transferred from Toronto to Barrie, Ont., where he is with the small appliance department of the organization. Mr. Boundy was employed as a design engineer at Toronto.

G. M. Ross, JR.E.I.C., (B.Eng., electrical, McGill, 1955) is an engineer in the microwave group of Standard Telephones & Cables Mfg. Co. (Canada) Ltd., Montreal.

Frank S. Miller, JR.E.I.C., (B.Eng., chem., McGill, 1949) has been transferred by Scarfe & Company from Brantford, Ont., to Montreal. Formerly sales engineer, he is now branch manager for the province of Quebec.

Ronald S. Butcher, JR.E.I.C., (B.Eng., mechanical, Nova Scotia Technical College, 1954) is a design engineer for Atomic Energy of Canada Ltd., at Chalk River, Ont.

Mr. Butcher received the Athlone Fellowship in 1954.

William Taciuk, JR.E.I.C., (B.Sc., chemical 1951; B.Sc. elec. Alberta, 1954) is now employed by Imperial Oil Limited as process engineer, technical department, New Westminster, B.C.

Raymond Dumas, JR.E.I.C., (B.A.Sc., civil, Laval 1954), is now with the Standard Paper Box Company, Montreal.

He was formerly with Concrete Repairs & Waterproofing Co. Ltd., Hydro-Quebec, Labrieville, Que.,

P. F. Phelps, JR.E.I.C., (B.A.Sc., engineering and Business, Toronto, 1955) is employed by Canadian Westinghouse Company Ltd., Hamilton, as sales engineer in their power transformer sales department.

F. R. Scrase, JR.E.I.C., (B.Sc., civil, Manitoba, 1955), has been associated with Canadian National Railways for the past two and a half years at various locations as a junior assistant engineer.

Mr. Scrase has recently transferred his services to the Department of Public Works, Province of Manitoba. He is employed in the Highways Branch, Winnipeg.

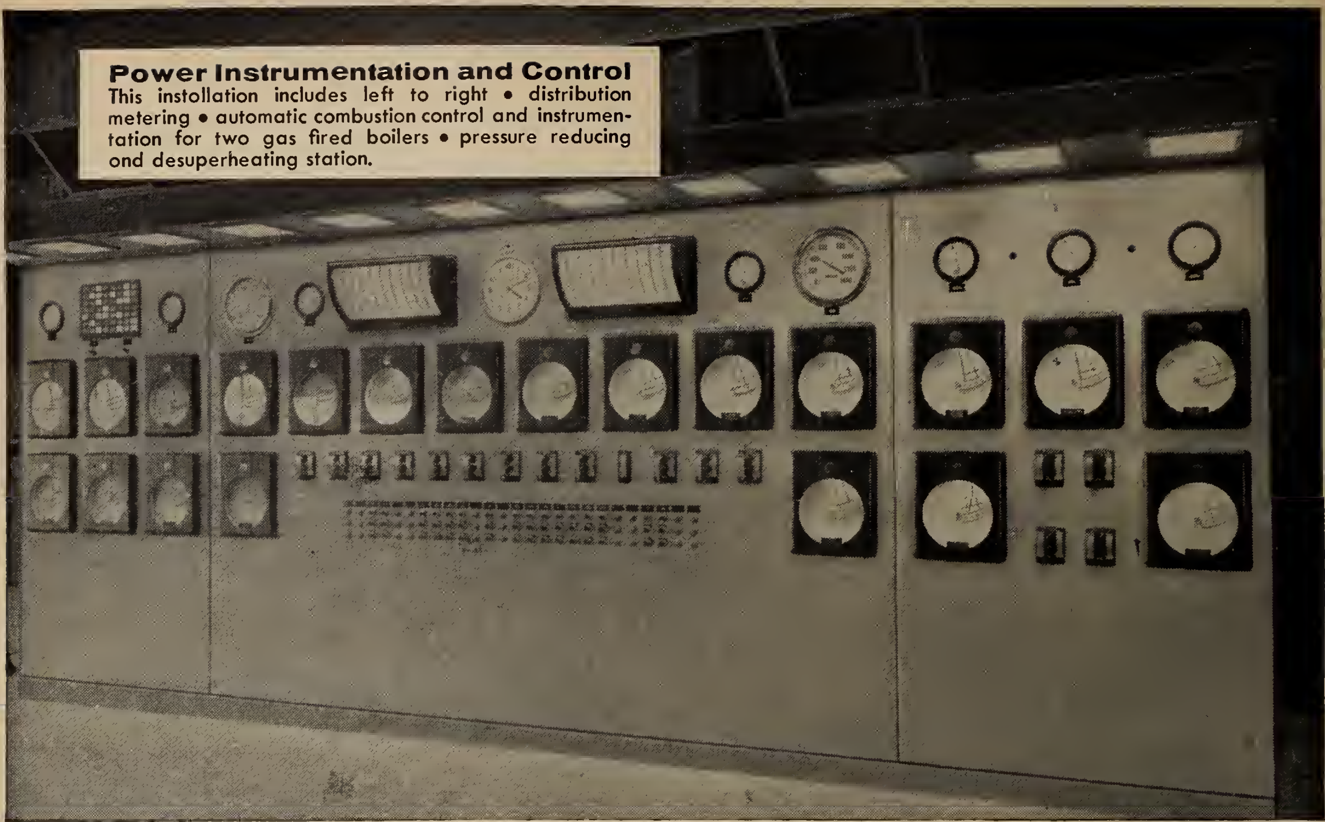
J. M. Katrusiak, JR.E.I.C., (B.Eng., civil, McGill, 1956) has left the Power Corporation of Canada Limited, Montreal, where he was employed as a design engineer and has joined the staff of Dominion Glass Company Limited, Montreal.

B. C. Doell, JR.E.I.C., (B.Sc., civil, Saskatchewan, 1953), assistant hydraulic engineer for the Department of Public Works, for Ontario, has been transferred from Fort Frances to Toronto.

D. S. Simons, JR.E.I.C., (B.Sc., electrical, Manitoba, 1949) is terminal station and transmission engineer for the Manitoba Hydro-Electric Board, Winnipeg.

Paul R. Ukrainetz, S.E.I.C., (Sask., 1957), Athlone Fellowship winner of 1957 is living at Bristol, England, where he is undergoing practical training in aeronautical engineering with the Bristol Aircraft Company.

James Swim, S.E.I.C., (B.Sc., civil, New Brunswick, 1957), has accepted a position with the New Brunswick Telephone Company Limited, at Saint John, N.B.



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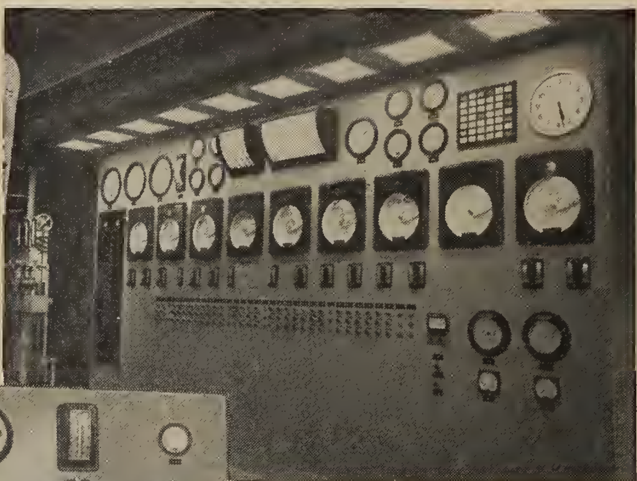

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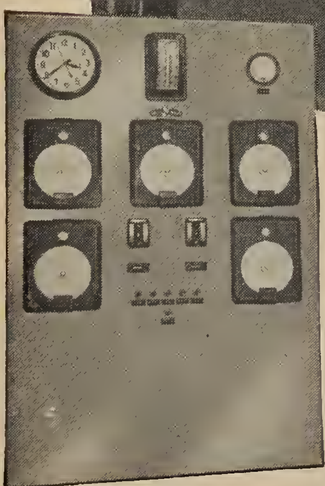

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NEWS OF THE BRANCHES

Activities of the Forty-Nine Branches of the Institute and abstracts of the papers presented at their meetings

AMHERST

G. R. Pond, JR.E.I.C., *Sec.-Treas.*

THE PRESIDENTIAL TOUR of the Amherst Branch took place on November 20, 1957. A civic welcome, extended by Councillor D. W. Tingley, was followed by a reception at which members and guests were introduced to President Anson. In the dinner address entitled, "The Engineer in Management," the president stressed the growing importance of the engineer in industrial management and labour relations. With increasing frequency the engineer is being selected to manage the many and varied components of our industrialized civilization, he said. It was therefore inevitable that the natural course of evolution should reveal the engineer as best fitted to assume the increasing responsibility of management. He has had, he added, the correct training, a training which stressed the paramount need for producing and basing decision on facts. In whatever employment he may be engaged, the engineer will find himself dealing with and directing people. This involves a knowledge of finance, governmental procedure and law. It demands adeptness in vocal communication to men in all walks of life. Thanks on behalf of the Branch was expressed by R. L. Alexander.

Vice-president of the Institute for the Atlantic provinces, H. W. L. Doane of Halifax, introduced by L. E. Burrill, produced some interesting statistics on the progress made by the Institute over the last ten-year period.

Entertainment and dancing followed the talk.

AMHERST: Assembled on the occasion of his visit to Amherst, N.S., are President Anson, Mrs. Anson, branch members and their wives. Left to right they are: Mrs. Rockwell, D. J. Rockwell; L. E. Burrill and Mrs. Burrill; D. W. Tingley, councillor and Mrs. Tingley; Mrs. Anson, President Anson; Mrs. Wilson and J. W. Wilson, Branch chairman; Mrs. Pond and Roy Pond, branch secretary; and H. W. L. Doane, vice-president of the Engineering Institute, Atlantic Region.

BELLEVILLE

T. E. Hilbig, JR.E.I.C., *Sec-Treas.*

EVALUATING PERFORMANCE in an engineering department was the subject of a talk when H. L. Johnston, chief engineer of Du Pont of Canada (1956) Limited, addressed the regular monthly meeting in December. This paper was reported in the December isssue of the Journal by the Nipissing and Upper Ottawa Branch.

In the ensuing question and discussion period it was apparent that a number of members were comparing Mr. Johnston's system of rating employees with those used by their companies.

Papers chairman, Dave Pullen listed an interesting program for the remainder of the 1957-58 season. On January 13, 1958 M. G. Townsend of The Northern Eectric Company, Montreal discussed industrial health. Dr. A. E. Berry of the Department of Public Health, Toronto, delivered a talk on water pollution and sewage disposal. It is intended that on March 10, a Branch tour of the Pryotenax Company plant at Trenton, Ontario will be made. The chemical composition of the universe will be explained by Dr. J. B. Oak, of the Department of Astronomy, University of Toronto, on April 14. Finally, the spring program will be concluded, May 12 with a film and lecture devoted to illustrating the means available for the manufacture and use of plywood.

CALGARY

O. O. Junker, M.E.I.C., *Secretary*

Fred L. Perry, M.E.I.C.,

Publicity Committee Chairman

AN OUTSTANDING AUTHORITY on atomic energy was heard by members of the Calgary Branch of the Institute on December 4, 1957. J. L. Olsen, manager of marketing research for the civilian atomic department of the Canadian General Electric Company at Peterborough, Ont., addressed the group on "A Current Review of the Atomic Power Business."

A brief explanation of the fundamentals of fissioning and nuclear power and a discussion on the uranium industry in Canada was given. Comparison between the various types and forms of reactor fuel used, as well as comparison of the various types of reactors built in Canada, the United States and Great Britain was made. Economic reasons for the courses taken were explained. Problems associated with each design were traced. Power requirement and supply in Canada and comparison with a number of foreign countries was presented. The importance of nuclear energy in Canadian planning for the future was also discussed.

The talk was accompanied by slides and various fuel samples.

A.C.E. Professional Development Program

The A.C.E. Professional Development Program initiated by the Calgary Branch of the Engineering Institute of Canada was organized under the joint sponsorship of the Alberta Society of Petroleum Geologists, the Canadian Institute of Mining and Metallurgy and the Engineering Institute of Canada. Its program was briefly reported in the November Journal. The Program, held at Calgary's modern Southern Alberta Jubilee Auditorium, began with two afternoon-dinner-evening meetings in the spring of 1957. As a result of interest displayed at that time, the program of adult education was arranged.

The purpose of the program is to assist engineers and earth scientists to broaden their knowledge and interest in matters beyond their present daily tasks; to become more interesting people who will find increased enjoyment in living and in the world around them and who will have greater potential for advancement in the professional and managerial world.

Presented on alternate weeks, for a two-hour session, the emphasis is placed on participation of members at the meetings. It is one of the aims of the program to give members an opportunity to gain experience and confidence in expressing their views in open meeting. Accordingly the speakers of the evening are asked to present the subject background in the course of one hour, followed by a short break. Meetings then reconvene for questions and discussion.

The 1958 program features such diversified matters as: government, arts and literature, human relations and finance, covered by well-known speakers throughout the province in a total of eight talks.

Fee set for the course was ten dollars with an additional charge for each dinner meeting.

Business management, government, arts and literature, and self-development comprised the subjects dealt with in the 1957 portion of the course which began during September.

TWO TECHNICAL MEETINGS both of them dinner meetings, were arranged for the Calgary Branch during the winter term. The first of these, held January 16, at the Southern Alberta Jubilee Auditorium featured two speakers. First on the program J. E. Oberholtzer, deputy minister of the Department of Industries and Labour, Edmonton, Alta., spoke on "The Present Industrial Picture in Alberta," covering development over the past ten years, and making comments on future possibilities for the province.

Following the dinner Dr. D. C. Rose gave a talk on "The International Geophysical Year" with emphasis on the part played by Canada. He gave special mention to the work of the Cosmic Ray Research Station at Sulphur Mountain, Banff, Alta.

Dr. Rose is a research officer with the National Research Council, and is chairman of the Canadian National Committee for the International Geophysical Year.

KINGSTON

D. I. OUROM, M.E.I.C., *Sec.-Treas.*

NATIONAL RESEARCH COUNCIL recently developed a machine to facilitate the

• BRANCH NEWS

production of accurate models required for tests in the Council's laboratories. The machine was described by G. J. Klein, of N.R.C., at a meeting of the Kingston Branch, held at Queen's University, January 14, 1958.

The machine was primarily designed to cut reference contours of ship models up to 25 feet long and made of wood or wax. It can also be used to cut contours of many other items, such as fan blades. It has ample rigidity and power to cut light metals. Cutter feed is controlled automatically by a 360 degree tracer system guided by a spline clamped along a contour on a master drawing. The machine manifests advanced design features of special interest to engineers.

LAKEHEAD

C. M. Cotton, JR.E.I.C., *Sec.-Treas.*

G. A. Walker, JR.E.I.C., *Publicity Committee*

A JOINT MEETING of the Lakehead Branch of the Institute with the Association of Professional Engineers of Ontario was held December 13. Fifty members heard J. H. Fox, president of the Ontario Association, discuss current problems facing the professional engineering group in Canada. Among points raised were the rating of other semi-professional groups into various classifications such as technicians and technologists. The important problem of national confederation was discussed. A working outline of the organization was presented along with some of the problems to be encountered before the organization could become a reality. Mr. Fox expressed optimism in this endeavor providing members be prepared to overlook minor personal sacrifices in realizing broad advantages to be gained.

An interesting comment in regard to the fact that presidents and vice-presidents are not voted into office, was made by Colonel Medland who said that such duties are particularly demanding and involve one-third of a man's waking hours and a great deal of travel. Presidential visits had involved 25,000 miles of travel during 1957. It could be understood, he felt, that a year's notice is necessary if one is to be prepared for such a schedule.

Mr. Fox was introduced by Branch chairman V. B. Cook, R. B. Chandler extended thanks.

An informal meeting was held following the luncheon in order that members acquaint themselves with the visiting officials.

TORONTO

D. S. Moyer, M.E.I.C., *Sec.-Treas.*

A. C. Davidson, M.E.I.C., *Branch News Reporter*

THE ENGINEERS' RESPONSIBILITY in School Planning was the subject of an address delivered by Zeph A. Marsh, director of school activities for the Minneapolis Honeywell Company to an evening meeting of the Toronto Branch, December 5.

Introduced by John Fox, president of the Association of Professional Engineers of Ontario, Mr. Marsh spoke on the more efficient construction of schools as an aid to the education field.

Giving special mention to ventilation he urged that various groups within the school system, such as teachers and students meet with those planning the design and construction of a new school in order to discuss the matter. One point which Mr. Marsh felt did not receive adequate consideration was that of ventilation.

After discussing some other mechanical details which could make for better schools Mr. Marsh gave a breakdown of the cost of education. Eighty per cent of the budget is spent on salaries. Nine per cent is used for capital investment (cost of the building) and 11 per cent is allowed for other costs. The construction of the schools should add to the efficiency of teachers and students.

THE JOINT TORONTO AREA COMMITTEE of the E.I.C., I.C.E., and the A.S.C.E. at

● BRANCH NEWS

a meeting on December 12 listened to D. A. Clough discuss the expansion of sewage disposal facilities in rapidly growing Metropolitan Toronto.

Mr. Clough began his talk by tracing the history of Metro-Toronto's population growth and the sewage disposal problem it created. He then indicated the overall plan which has been developed to satisfy the growing area. Details of some of the plants, both temporary and permanent, finished and still under construction were given. Colour slides made clear the immense amount of work which has been done.

It was felt that a citizen of Metro-Toronto would see the occasional manifestation of the construction, but would not readily grasp the picture.

President Anson's visit to the Toronto Branch at the time of the regular monthly meeting was an event of January 7, 1958. Together with the general secretary, Dr. L. A. Wright, the president attended a Branch executive meeting and dined with the executive before the regular evening meeting.

In his presidential address, delivered to the evening meeting, on the Engineer in Management, Mr. Anson outlined the ideal relationship between labour and shareholders. Mr. Anson favoured the engineer-trained manager as the man best able to serve the interests of both parties to the utmost advantage of the business partnership.

With mixed feelings, Dr. Wright who will retire shortly, referred to his twenty-two years of service and noted the material well-being which has come to the organization in that time.

A film entitled "The Four Seasons" was included in the proceedings of the event.

President Anson made an appearance on television appearing on the C.B.C. program "Tabloid".

SUDBURY

W. J. Ripley, M.E.I.C., *Sec.-Treas.*

M. D. Head, M.E.I.C.,
Publicity Committee

Sudbury district branch held a dinner meeting at the Granite Club on December 12 attended by thirty one members and guests. E. Querney introduced the speaker, L. Graham of the Northern Electric Company, who delivered an informative talk on the subject of high voltage cables. Mr. Graham traced their historical development from 1890, when a 10,000 volt cable installed by Feranti at Deptford, England, was considered hazardous and was banned by the local authorities, to the present time when 300,000 volt cables are in use, and experiments are being carried out with 800,000 volt cables in some European countries. The early cables consisted of a copper conductor surrounded by oil impregnated paper insulation. The first major design advance was made in 1914 by Hofstatter who invented shielding, that is, metallic covering outside the paper insulation to equalize voltage stresses and prevent the ionisation responsible for failure. This development permitted transmission at as high as 22,000 volts. In 1917 Emmanuell's oil filled core cable, and in 1925, Atkinson's and Fisher's inert gas filled pressure cable methods of construction further increased the allowable voltage applications. Improved methods of today for manufacture of the conductor and paper insulation, with the cable enclosed in pipe under oil pressures up to 200 p.s.i. permit operation at standard voltages of 230,000 or even 310,000.

Following his talk, Mr. Graham presented a film on the Steep Rock Dredge cable. This is a portable power line, using butyl rubber insulation, rated at 1500 volts, 500 amps., and as the speaker pointed out, hardly comparable with the high voltage cables referred to earlier. The film described the development of the Steep Rock iron ore project, which involved draining and de-silting the lake above the orebody, the manufacture of the cable and, finally, the operation of the dredge and monitors. A question period followed.

T. C. Robertson expressed the enthusiastic appreciation of the meeting.

News of Other Societies

International Labour Conference

The fortieth session of the International Labour Conference held in Geneva, Switzerland in June 1957 drew more than 900 delegates, advisors and observers from 73 member countries and 10 territories. A report of the Canadian Employers Delegation was issued late in 1957, from which the following is abstracted.

The 1958 budget of $7,972,901 was passed, supported by Canadian government and labour delegates. Canada was asked to conduct a panel on the subject of "The Role of Government in the Field of Labour-Management Relations." Speakers were G. V. Haythorne, government delegate, Claude Jodoin, worker delegate, and W. A. Campbell, employer delegate. Possibly the most heated argument before the Conference in many years took place over the question of the objections to the credentials of the government, worker and employer delegates of Hungary. Canadian Employers' delegates took an active part in these discussions.

Resolutions were accepted on the abolition of concentration camps and the deportation of national minorities, methods of wage payment, debt bondage and serfdom, abolition of anti-trade union laws, mine safety, women's work, workers' education and housing, non-metropolitan housing, hours of work, disarmament, testing of nuclear weapons, and use of nuclear energy for peaceful purposes.

There was a report of the director-general on automation and other technical development, labour and social implications.

The conference adopted a convention on forced labour and on weekly rest in commerce and offices and on discrimination in the field of employment and occupation.

Director David Morse was re-elected for another five-year term.

Eleventh Canadian Soil Mechanics Conference

Pile Foundations and Frost Action were featured at the 11th Canadian Soil Mechanics Conference, held in Ottawa, December 9 and 10. More than 200 engineers, contractors, geologists and soil scientists attended the meeting, sponsored by the Associate Committee on Soil and Snow Mechanics of the National Research Council.

The program of the first day was devoted to the subject of the bearing capacity of pile foundations and a visit to the soil mechanics laboratory of the Division of Building Research. The pile session was introduced by a paper prepared by Prof. I. F. Morrison and S. R. Sinclair of the University of Alberta. The paper reviewed was "Some Aspects of Pile Foundations".

Specifications for acceptance of wooden piles caused much interest and concern was expressed that when using crooked piles dynamic stresses during driving could exceed the ultimate strength of the outer fibres. Design considerations of lateral support for long slender piles were discussed and the question of corrosion of steel piles was raised. Attention was directed to recent work on corrosion in Norway. An interesting argument, pro and con, on the use of pile driving formulae developed. There was general agreement that the formulae were useful for determining the bearing capacity of piles in clean, granular soils and as specification for refusal.

A panel consisting of Prof. D. F. Coates, Carleton University, as moderator, Dr. G. G. Meyerhof, Nova Scotia Technical College, C. V. Antenbring, Cowin & Co., Winnipeg, E. I. Rubinsky, Raymond Concrete Pile Co., L. A. Fraikin, Franki Pile Co., and N. D. Lea, Foundation of Canada Engineering Corp. Ltd. then took up the subject.

Following a statement on "What is Pile Failure" the panelists discussed special cast-in-place piles (which are used extensively in Western Canada), the use of friction piles in soft clays, the bearing capacity of rammed-in-place concrete piles and some aspects of the National Building Code concerning the soil bearing capacity of piles. Subsequent discussion illustrated the design difficulties associated with friction piles and with establishing a satisfactory value for end bearing piles. The two main problems, of ultimate bearing capacity and settlement, were fully discussed and it was generally concluded that load tests were the best means of evaluating pile capacity.

The program on December 10 was devoted to frost action in soils. The first paper by E. Penner, Division of Building Research, summarized experimental findings on the conditions necessary for the growth of ice crystals in soil. This was followed by a description of the frost problem as it affects maintenance and operation of the Quebec North Shore & Labrador Railway by R. W. Pryer, the soils engineer of the railway. E. B. Wilkins, B.C. Department of Highways, then presented a paper on the design of flexible pavements considering the effects of seasonal variations in road bearing capacity caused by frost action.

J. J. Hamilton of the Division of Building Research, described an interesting case of severe damage to a cold storage plant caused by frost action. After 4 or 5 years of satisfactory operation the building began to heave at the centre and in less than 2 years the heave amounted to more than one foot. Temperature measurements showed that when the frost line penetrated to the footing level (and the level of fine-grained soil) the heaving became rapid. Corrective measures were explained and the plant is now back to its original level. A practical mathematical analysis of the general problem of heat flow under cold storage plants was presented by Dr. D. C. Pearce of the Division of Building Research.

Discussion on frost action covered a wide range of subjects. Much interest was shown in the relationships of loss of bearing capacity of highways to changes in density and water content of the supporting soil. The application of chemical treatment was considered at length.

The proceedings of the Conference will include summaries of the papers presented and will appear in the Technical Memorandum series of the Associate Committee on Soil and Snow Mechanics. It will be available in the spring of 1958.

Correction: An article in the November issue of the *Journal* News of Other Societies, quoted the price of three volumes on the Fourth International Convention of Soil Mechanics, obtainable from Butterworth and Company (Publishers) Ltd., London, Eng., to be $70.00. The price is however, $105.00 delivered, from Butterworth and Company (Canada) Ltd.

Canadian Management Council

The Canadian Management Council, a part of the International Committee for Scientific Management, that body concerned with the research, development and dissemination of management knowledge, known as C.I.O.S., held its annual general meeting in Montreal on October 29, 1957. C.M.C. came into being ten years ago.

• OTHER SOCIETIES

Referring to C.I.O.S. activities during the past two years president Bruce A. Hills, reported that eight papers contributed by C.M.C. were presented at the C.I.O.S. meeting in Paris in 1957. Considerable publicity has been accorded C.M.C.; the submission to the Royal Commission on Canada's Economic Prospects was favorably received in the press.

During the past year C.M.C. was consulted by the Engineering Institute of Canada relative to their management section of the Annual Meeting held at Banff in June 1957. This took the form of a panel discussion on "The Selection and Training of Second Line Executives" at which Mr. Hills took the chair. Assistance was also given to the Junior Management section of the E.I.C. in the matter of a winter seminar.

Tribute was paid to A. M. McKenzie, chairman of the Council whose death in 1956 was severely felt. Mr. MacKenzie had devoted his enthusiasm and experience to the problems affecting C.M.C., particularly its future.

The directorate of the council has been enlarged to include the president or a representative of the member societies who could take an active part in directing the affairs of C.M.C. on behalf of his association or society.

Calendar

1958 Nuclear Congress

More than thirty engineering and scientific societies are completing plans for the Fourth Nuclear Engineering and Science Conference to be held at the Chicago International Amphitheatre March 17-21, 1958. The Congress will demonstrate its progress in the uses of nuclear energy for the benefit of the Western World. For information contact: Joel Henry, Congress Manager, American Institute of Chemical Engineers, 25 West 45 Street, New York 36, N.Y.

The 1958 Nuclear Congress is an assembly of the Fourth Nuclear Engineering and Science Conference; the Fourth International Atomic Exposition; the Sixth Hot Laboratories and Equipment Conference and the National Industrial Conference Board, Sixth Atomic Energy in Industry Conference.

Preprints of Congress papers at fifty cents each may be ordered from the order form to be included in the Advance Program for the Congress which will be distributed in January.

Those interested should request copies of this program from the secretary of the society to which they belong or from the Secretary of Engineers' Joint Council, 29 West 29 Street, New York 1, New York.

American Power Conference

The twentieth anniversary meeting of the American Power Conference will be held March 26-28, 1958, at the Hotel Sherman in Chicago.

The conference is sponsored annually by the Illinois Institute of Technology in co-operation with 14 colleges and universities and nine technical societies. Inquiries should be addressed to: R. A. Budenholzer, Esq., Conference director, Mechanical Engineering Department, Illinois Institute of Technology, 3300 Federal St., Chicago 16.

British Electrical Conference

The 1958 British Electrical Conference will be held at Brussels, May 16-17, under the patronage of the Belgian Commissariat-General, 1958 Universal and International Exhibition, Brussels.

For further information contact: The Organizing Secretary, 1958 British Electrical Conference, 36 Kingsway, London, WC2, England.

I.I.W. to Meet in Vienna

The annual assembly of the International Institute of Welding will be held from June 29 to July 6, 1958 in Vienna, Austria.

After the annual assembly participants will have the opportunity to choose one of the tours to a number of leading industrial establishments in Austria. Guests will be shown scenic parts of the country and acquainted with culturally important places.

A detailed program of the congress may be obtained from: W. R. Stickney, Executive Secretary, Canadian Council of the International Institute of Welding, 7 Pleasant Boulevard, Toronto, Ont.

For those who may wish to holiday in Austria after the congress the Austrian Organizing Committee is willing to undertake arrangements. Application for such arrangements must be made before January 31, to: Oesterreichisches Organizationkomitee, IIW/IIS Jahresversammlung 1958, c/o Schweisstechnische Zentralanstalt, Wien XVIII, Schumanngasse 31, Austria.

Tool Engineers Annual Meeting, Tool Show

The American Society of Tool Engineers will hold an annual meeting and tool show, May 1-8, 1958, at the Philadelphia Convention Centre, Philadelphia, Pa. For further information write: 10700 Puritan, Detroit 38, Mich.

Instrument Society Symposium

The Tenth annual symposium of the New Jersey section of the Instrument Society of America will be held April 1, 1958, at the Essex House, Newark. Control systems engineering is the subject to be covered at the conclave. Further information may be had on writing: Norman Dayton, Esq., Registration chairman, c/o Norman Brager Company, 1060 Broad Street, Newark, New Jersey.

Steel Founders' Society Annual Meeting

The fifty-sixth annual meeting of the Steel Founders' Society of America, will be held at the Drake Hotel, Chicago, Ill., on March 17 and 18, 1958. Enquiries should be directed to: George K. Dreher, market development director, Steel Founders' Society of America, 606 Terminal Tower, Cleveland 13, Ohio.

Chemical Institute Meet

A joint conference of the American Institute of Chemical Engineers and Chemical Engineering subject division, C.I.C., Montreal, Que., will be held from April 20-23, 1958. For further information write: The Chemical Institute of Canada, 18 Rideau Street, Ottawa 2, Ontario.

Plastics Society Conferences

The Sixteenth Annual S.P.I. Canadian Section Conference will be held at the Royal Connaught Hotel, at Hamilton, Ont., on March 6 and 7, 1958, by the Society of the Plastics Industry Canada, Incorporated. For further information contact: the Canadian office at 77 York Street, Toronto, Ont.

The Fifteenth Annual Pacific Coast Section Conference of The Society of the Plastics Industry, Inc., will be held March 26, 27, 28, at El Mirador Hotel, Palm Springs, California. For further information contact: The Society of the Plastics Industry, Inc., 250 Park Avenue, New York 17, N.Y., U.S.A.

Muskeg Research Conference

A Muskeg Research Conference will be held in Ottawa, Tuesday, 11 March 1958. This conference is the fourth such annual meeting and is sponsored by the Associate Committee on Soil and Snow Mechanics of the National Research Council of Canada.

Anyone interested in attending this conference should write to I. C. MacFarlane, Division of Building Research, National Research Council, Ottawa 2, Ontario.

Convention on Radio Aids to Aeronautical and Marine Navigation

27 and 28 March, 1958

This Convention will be held in the Institution of Electrical Engineers building, Savoy Place, London W.C.2.

Members of E.I.C. are invited to attend the sessions. Will any who plan to be present please inform the General Secretary, Engineering Institute of Canada.

Library Notes

Additions to the
Institute Library
Reviews, Book Notes
Standards

BOOK REVIEW

REGIME BEHAVIOUR OF CANALS AND RIVERS

This book deals with the hydraulics of rivers and canals with mobile boundaries, that is, those flowing in alluvial soil deposits. A vast amount of civil engineering construction work is associated with such streams. To be adequate the engineering on such projects must assess with a reasonable degree of accuracy the immediate and long term effects of the construction on the equilibrium flow conditions, (stream regime), and also the fluctuation in conditions which are to be expected within the normal regime conditions.

A review of current engineering literature will convince one that substantial damage is continually occurring to engineering works due to inadequate analysis of the conditions governing the flow of rivers having mobile boundaries. More difficult of assessment is the economic waste resulting from the "factor of ignorance" which of necessity has been applied to such works due to lack of understanding of the natural laws involved.

The author is professor of civil engineering at the University of Alberta and assumed his present position after some twenty years experience in irrigation and river work in Pakistan and Hindustan. It has been the experience over the past seventy years with the behaviour of irrigation canals and rivers in these areas which has made possible the systematization of this specific branch of hydraulics, and its extension from the field of canal design to rivers with mobile boundaries.

At the present time little is taught on this subject at the universities and the material presented in the standard texts and handbooks has been largely along purely qualitative lines. The major contribution of this book is that after a review of the qualitative approach it proceeds to methods of quantitative analysis which are not currently appreciated by the practising engineer or the young student of hydraulics. Information is presented permitting a rational analysis to be made of such specific problems as depth of scour for bridge piers, control works for rivers, effects of damming on the overall river equilibrium and stable canal cross-sections, to mention but a few such practical problems. The book also includes an interesting chapter on the application and design of river models.

Advanced training in the field of hydraulics is not assumed of the reader. The book is written for those with an average civil engineering background, and the vocabulary peculiar to the subject is carefully defined. It will be of interest to the young engineer who wishes to broaden his background in the general field of hydraulics, as well as to the practising engineer, who from his experience is aware of the importance or problems of river hydraulics in civil engineering construction. (T. Blench. Toronto, Butterworth, 1957. 138p., $6.00.)

Dean R. M. Hardy, M.E.I.C.

Members may borrow the books mentioned in these Notes on application to the librarian. Two books may be borrowed for two weeks.

LIBRARY HOURS

Monday to Friday

9 a.m. — 5 p.m.

Saturday

9 a.m. — 12 noon

BOOK NOTES

Prepared by the Library, The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

AIR CONDITIONING — REFRIGERATING DATA BOOK, DESIGN VOLUME

In this volume are found the fundamental engineering facts on which the companion volume to this, Applications, is based. It has been largely revised, and includes an expanded index.

Topics covered include: Theory, heat transfer fundamentals, fluid flow, compression refrigeration, etc.; Physical data on refrigerants, brines, piping, moisture, lubrication and thermal insulation; Application design, load and air conditioning calculations, air distribution, etc.; Basic equipment, compressors, condensers and evaporators; Auxiliaries, fans, cooling towers, household refrigerators, etc.; Operation. Also included are various tables, codes and standards, abbreviations and symbols, definitions, a list of refrigeration associations, and a classified buyers guide.

This is the last of the series of the two-volume Data Book which has been published since 1932. In future the Society will publish 4 volumes, Refrigeration Applications; Air Conditioning Applications; Refrigeration and Air Conditioning Equipment; Refrigeration and Air Conditioning Tables and Fundamentals. The first three will appear in three consecutive years, and the fourth will be published every five or ten years. (New York, American Society of Refrigerating Engineers, 1957. Irreg. paging, $10.50.)

• LIBRARY NOTES

APPLICATIONS DE LA THEORIE DU FLUAGE

Translated from the Russian by P. Mrozowicz, a consulting engineer and professor of civil engineering at the Ecole Nationale des Ponts et Chaussees, this volume is the first to attempt to take the creep of materials into account in calculating their resistance.

The book is concerned with various questions of plasticity, and with the development of theoretical methods of construction calculations, especially in concrete and reinforced concrete, which will take into account the creep of materials. The material in the book is the result of experiments conducted at the Institute of Mathematics and Mechanics of the Academy of Sciences of the Armenian S.S.R.

The first two chapters consider the theory of creep based on the general law of the relation between stress and deformation, and present equations for solving two of the problems connected with this. The second and third parts of the book are concerned with concrete and reinforced concrete construction, and the applications of the general equations.

The treatment is mathematical, but, as M. L'Hermite says in his preface to the book, it is a valuable piece of research, and will be of interest to many engineers. It is unfortunate that the results of Russian research cannot be made available in this way more often. (N. Kh. Aroutiounian. Paris, Eyrolles, 1957. 319p., fr. 4765.)

BIEGE—UND TORSIONSVERFORMUNGEN DÜNNWANDIGER STÄBE MIT OFFENEM PROFIL

Translated from the Russian edition published in 1952, this treatment of the subject of bending and torsion performance of thin, open structural shapes will be of interest to those concerned with design where the stresses of thin members must be taken into consideration.

The theories and results given in the first two chapters are applied in the third which consists of worked examples. (J. I. Jagn. Leipzig, Teubner, 1957. 79p., DM 7.20.)

CAHIERS DE SYNTHESE ORGANIQUE

In this series, the authors' intention is to create a new type of organic chemistry textbook for chemists working in laboratories and research departments in the field of organic synthesis. The reactions and methods of organic chemistry are arranged in a different manner to that usually found, and reactions which are similar in their principles, mechanism, or results are grouped together.

The series will be completed in ten or twelve volumes, and is divided into four sections: the growth, breakdown, and transposition of compounds, and their cyclization.

In each chapter, the different reactions are developed according to their importance, but even minor ones are not

neglected if they are of interest. The principal reactions are given with a brief critical examination of the conditions of the experiment, secondary reactions, and fields of application. Many examples and references are included. (Jean Mathieu and Andre Allais. Paris, Masson, 1957. 3 vols., fr. 4200, 4400 and 4400.)

EPICS OF INVENTION

The nine great men whose biographies appear in this book have, through their inventions, caused great changes in the world.

The first in time, although not necessarily in importance was Richard Trevithick, the probable actual inventor of the steam locomotive, so often associated with Stephenson. The other inventors and inventions included are Humphrey Davy and the miner's safety lamp; William Henry Perkins and aniline dyes; Friese-Greene and motion pictures and John Baird and television. Four men whose name is known to everyone also find their place in this book: Ford, Marconi, Watson-Watt and Whittle.

The lives of the inventors are presented against the background of their own time, and the book will appeal to the general reader. It would be an excellent gift to the student interested in science and engineering, or to a school or public library. (John Rowland. London, Werner Laurie, 1957. 206p., 12/6.)

EXPLANATORY HANDBOOK ON THE B.S. CODE OF PRACTICE FOR REINFORCED CONCRETE, NO. 114, 1957

This new edition of the Handbook is in the same form as previous editions, and is based on the revised B.S. Code of Practice which is included in its entirety. The Code is indicated by black lines in the left-hand margin. Each clause is followed by the authors' explanations and comments. The Code now makes provision for the design of structures by the load-factor method, as well as by the elastic theory. Tables and figures prepared by the authors are separately numbered. (W. L. Scott, W. H. Glanville, F. G. Thomas. London, Concrete Publications, 1957. 154p., $3.00.)

FBI REGISTER OF BRITISH MANUFACTURERS

In the latest edition of this useful trade directory, the products and services of over 7,500 members of the F.B.I. are listed under more than 5,400 headings. F.B.I. in this instance stands for Federation of British Industries, and not the Federal Bureau of Investigation!

In addition to this classified buyers guide are included: glossaries of product terms in French, German and Spanish; and alphabetical lists of addresses of companies; trade associations; brands and trade names; and trade marks. (F.B.I. London, Iliffe, 1957. 1137p., 42/-.)

*FASTENERS HANDBOOK

For each fastener included in this complete handbook there is a picture or diagram and a paragraph or so on each of the following: description, features, uses, the standard material used in making the fastener and the standard sizes into which it is made. Anything unusual about the fastener or its use is given under "Remarks", and finally the name of the manufacturer is given. Types of fasteners include: rivets; inserts; screws; bolts and studs; nuts; washers; pins; nails; retaining rings; metal stitching; quick release fasteners; masonry anchoring devices; and hose clamps. An alphabetical list of the manufacturers with addresses is included at the end of the book. (Julius Soled. New York, Reinhold, 1957. 430p., $12.50.)

HANDBOOK OF ALUMINUM

This is a reference book on aluminum and its alloys, their production and the principal industrial processes for working and finishing them. The following topics are covered: properties of aluminum and its alloys; aluminum wrought products; castings; heat treatment of aluminum alloys; joining and finishing; general workshop practice. The tables give the composition, properties, etc. of various Alcan alloys, products, etc. (Montreal, Aluminum Co. of Canada, 1957. 266p., $3.00.)

*HANDBOOK OF LAYOUT AND DIMENSIONING FOR PRODUCTION

A practical guide to layout, detail design, and production dimensioning practices in the metalworking industries. Each step in product development from technical sketch to final drawing is illustrated and detailed in terms of the procedures, principles and theory involved. (H. H. Katz. Toronto, Brett-Macmillan, 1957. 479p., $15.00.)

*HANDBOOK OF NOISE CONTROL

Forty chapters with accompanying lists of references, provide comprehensive coverage of the nature of noise, its measurement, and techniques of its control in buildings, industry, transportation, and the community. Prepared by forty-six experts, the handbook treats vibration isolation, damping, and measurement; acoustical filters and mufflers; special types of noise such as that in bearings, gears, fans, water systems, and electric motors; and physiological, psychological, and legal aspects of noise. Examples from existing installations illustrate the application of methods for solving problems of noise control. (Ed. by C. M. Harris. Toronto, McGraw-Hill, 1957. Various pagings, $19.80.)

METHODS FOR EMISSION SPECTROCHEMICAL ANALYSIS, 1957

This compilation contains all the spectrochemical practices and methods published by the ASTM, as well as excerpts from other ASTM methods or practices which are of direct interest to people making use of emission spectrochemistry.

The book is divided into four sections: general practices, nomenclature, spectrochemical analysis of metals, and spectrochemical analysis of nonmetals. It contains about 80 suggested practices and methods altogether. (American Society for Testing Materials, Committee E-2. Philadelphia, ASTM, 1957. 490p., $7.00.)

PRINCIPES DE SYNTHESE ORGANIQUE; INTRODUCTION AU MECANISME DES REACTIONS

An introductory volume to the Cahiers de Synthese Organique noted above, this book considers the modern theories of organic chemistry, and presents a theoretical analysis of the mechanics of reactions. The four parts of the book cover electronic factors, the mechanics of reactions, steric factors, and steric aspects of reactions. (Jean Mathieu and André Allais. Paris, Masson, 1958. 598p., fr. 8500.)

PRESSURE MEASUREMENT IN VACUUM SYSTEMS

Several books have been written on vacuum technology in general, but this is the first to be devoted exclusively to the measurement of pressure. The choice of a suitable pressure gauge in vacuum systems and correct interpretation of its reading are important because neither a bad design nor an incorrect interpretation is obvious at once.

The first five of the six chapters in the book are concerned with the different methods of pressure measurement in use, and the last chapter discusses gauge calibration. Topics covered include mechanical manometers, thermal conductivity gauges, ionization gauges, the Knudsen radiometer gauge and surface reaction techniques. (J. H. Leck. London, Chapman and Hall for the Institute of Physics, 1957. 144p., 30/-.)

PROCEEDINGS OF THE THIRD INTERNATIONAL CONFERENCE OF MANUFACTURERS

The three topics considered at this third conference held in New York in December 1956 were nuclear energy; automation; and modern management, the internal organization of companies.

The three basic conference papers were all printed in full, as are the addresses given at the conference luncheons and banquet and the opening and closing plenary sessions. It was unfortunately not possible to include the proceedings of the working parties in which more than 200 delegates participated.

In his paper on Nuclear Energy, John Jay Hopkins the Chairman and President of General Dynamics Corp. considered the world's energy requirements, and how they can be met by atomic energy, the effect of atomic energy on industry, and some of the problems connected with its development. He presented a summary of international atomic energy developments, and included a brief, non-technical description of the fundamentals of nuclear energy.

Malcolm P. Ferguson the President of Bendix Aviation Corp. concentrated on the economic aspects of automation, discussing what was meant by it, the factors determining its growth and adoption, and its effect on labour and business.

The final paper by Milton C. Lightner, the President of the Singer Manufacturing Co. considered the management of business, the need for systematic organization, its principles, and their practice. (New York, National Association of Manufacturers, 1957. 278p., $7.50.)

QANTUM MECHANICS, 2ND ED.

In this second edition of a book first published in 1954 the approach and scope of the first edition have not been changed, but two new topics have been included. One of these is partial wave analysis in scattering theory, an important subject in atomic, nuclear and high-energy physics. The second is the Dirac equation. Other minor changes and corrections have been made.

Other subjects covered include: wave-mechanical concepts; energy eigenfunctions, matrix mechanics; systems of many particles; time independent perturbation theory; collision processes; an introduction to group-theoretical ideas; the relativistic theory of the electron.

Problems are included with each chapter, and there is a bibliography. The author is a member of the Atomic Energy Research Establishment at Harwell. (F. Mandl. Toronto, Butterworth, 1957. 267p., $7.00.)

REFERENCES ON FATIGUE, 1956

This list of references to articles published in 1956 dealing with fatigue of structures and materials is the seventh to be issued by the American Society for Testing Materials. Earlier lists cover the period 1950-55. A brief abstract is given for each article, and the material is mimeographed and arranged so that it can be cut and filed on cards if desired. (Philadelphia, ASTM, 1957. 68p., $3.00. s.t.p. no. 9-H.)

REPAIRING HI-FI SYSTEMS

Written both for technicians and for the many owners of hi-fi systems who, from choice or necessity, do their own repairs, this book covers all phases of servicing. It discusses the location of faults in, and servicing of, amplifiers, preamplifiers, tuners and tape recorders, as well as their installation. (David Fidelman. New York, Rider, Toronto, Pointon, 1957. 203p., $3.90.)

SPACE RESEARCH AND EXPLORATION

Published some months before the arrival of Sputnik, this collection of twelve articles for the layman provides a concise introduction to the theories and problems of space exploration. The authors are all prominent in Great Britain in this field,

• LIBRARY NOTES

and have combined to present a survey of the whole subject from the construction of rockets and the research already done on the upper atmosphere to the launching of satellites and the possibility of travel to the nearer planets.

The problems actually facing research workers, and the way in which they might be overcome are discussed under the following headings: Rockets and rocket propellants; Exploration of the upper atmosphere; Cosmic radiation and space-flight; meteor hazards; Manned satellite stations; Interplanetary orbits; Difficulties of space navigation; Medical and biological problems; Conditions on the moon and nearer planets.

The main text can easily be understood by a reader with no scientific training, but accuracy has not been sacrificed. Where it appeared that a mathematical treatment would be useful, it has been included in the appendix. (Ed. by D. R. Bates. London, Eyre and Spottiswoode, 1957. 224p., 25/-.)

SPANNBETONBAU, TEIL 2

This second volume on prestressed concrete structures contains many detailed tables, diagrams and photographs, as well as a 223 item bibliography covering the years 1896 to 1956.

The first part of the book deals with construction: the method of construction of prestressed concrete supporting works; formwork for bridges, high buildings and underground works; reinforcements; prestressing cables. The second and third parts deal with the use of prestressed concrete in bridges and high buildings. The last section describes the various jacks used for prestressing, mixing concrete, etc.

The first volume covered the principles of prestressed concrete, the materials used, and design calculations. Together, the two volumes form a valuable treatise on the subject of prestressed concrete construction. (Wolfgang Herberg. Leipzig, Teubner, 1957. 407p., DM 26.)

STRENGTH OF MATERIALS

In this undergraduate textbook, particular attention has been paid to the order in which the material is presented, and the topics are developed to the point where further elaboration is unnecessary from an engineering point of view, or where further development would require the use of mathematics beyond the scope of an undergraduate.

Throughout, the emphasis is on material which forms the basis of all types of structural analysis and design, with examples drawn from the civil, aeronautical and mechanical engineering fields. The scope of the book is in some respects different to that which might be expected: for example, the principles of statistics have been reviewed early, and extended to cover two-dimensional force fields; energy has also been included. Emphasis has been placed on the direct use of curves, and the solution of problems by the use of tabular computation forms.

Some subjects usually found only in advanced courses are treated here in a simple way. These include methods of predicting inelastic behaviour under combined stresses, and the buckling loads for inelastic eccentric columns, and a method of design for repeated loading under stresses of variable amplitude.

The author has drawn on his many years of experience in the industrial and teaching fields in the compilation of this book which is a valuable addition to the literature on the subject. (F. R. Shanley. Toronto, McGraw-Hill, 1957. 783p., $8.93.)

THE SUPPLY AND DEMAND OF ENGINEERS, 1950-1960

This report issued by Deutsch and Shea analyzes the present situation regarding the supply and shortage of engineers, and forecasts future trends.

It shows that in the last seven years over 46,000 engineers a year have been needed in the United States, and less than 34,000 have graduated from university. The demand will increase in the next few years, and it is unlikely that the shortage will be met until 1960 or even later.

Much of the material is presented in tabular form, and for the years 1950-1957 the information given includes: the supply of engineers; additions to the profession; number of engineering graduates; supply and demand of engineers by field.

The report points out that the demand for engineers depends on the amount spent by industry and government on research and development, etc. The forecast demand per year is over 46,000, but the estimated number of graduates falls short of this. The number of college graduates is expected to increase in the 1960's, but the proportionate number of graduates will increase only if every effort is made to make the profession attractive to students.

Although this report applies to the United States, conditions in Canada are much the same, and presumably will continue to be. This Deutsch and Shea report and their earlier one, The Profile of the Engineer, are very interesting analyses of the profession. (Deutsch and Shea. New York, Industrial Relations News, 1957. 56p., $3.00.)

TECHNICAL DRAWING
PART 2 APPLIED GEOMETRY
PART 3 ENGINEERING PRACTICE

The first part of this text contained a basic introduction to the subject of technical drawing intended for students in technical schools.

● LIBRARY NOTES

Part 2 deals with the geometric constructions which the student needs to know: rectangles, triangles, polygons, circles, parabola, loci, spirals, etc. The second section of the book deals with the principles of projection.

In Part 3 the constructions and geometry covered in the first two parts are applied to the preparation of engineering drawings. No practical engineering knowledge is required, and the examples given are limited to the common fastenings and simpler engineering parts.

Some knowledge of elementary engineering technology is desirable in using these books, and if the student actually handles the components he is drawing, it is much better. (W. Abbott. London, Blackie, 1957. 2 vols., 7/6 each.)

TECHNICAL REPORT WRITING

Intended for both undergraduates and practicing engineers, this book covers the fundamentals of technical report writing, emphasizing method, and concentrating on the actual writing of the report. The author has tried to apply the principles of engineering design with which his readers are familiar, to the writing of industrial reports. He treats the subject under four headings: Analysis, the purpose of the report, its role and its audience; Investigation, gathering and evaluating material; Design, determining content, form, and illustrative material; Application, determining the point of view, writing the report, checking and modifying it, and preparing the final copy.

As the author points out in his introduction, effective writing is not easy, but it can be made easier by a liberal expenditure of time and effort. Mr. Souther's book should be a great help in showing how both may be put to the best advantage. (J. W. Souther. New York, Wiley, 1957. 70p., $2.95.)

TRACER APPLICATIONS FOR THE STUDY OF ORGANIC REACTIONS

Written primarily for organic chemists, who are interested in the organic reaction rather than the use of the isotope, this book is essentially a review of existing literature. The author tries to provide a comprehensive survey of tracer applications in organic chemistry, and a general idea of the principles of isotopic tracer use. He also includes background information on the reaction mechanisms so that the advantages and disadvantages of the method can be judged.

The topics covered include: isotopic exchange reactions; proton transfer in nonaromatic substances; free radical processes; carbonium ion processes; polymerization reactions, etc. The bibliographies contain a list of text books on the properties, uses and analysis of isotopes; a list of review articles on the application of isotopes; the papers on the subject which appeared from 1952 to 1955. (J. G. Burr. New York, Interscience, 1957. 291p., $7.50.)

YEAR BOOK OF THE HEATING AND VENTILATING INDUSTRY, 1957

The five technical articles at the beginning of this yearbook deal with the following topics: a long term analysis of fuel consumption; nomograms for finding the heat conductance of closed air spaces; technical education for the heating and ventilating industry; a review of the industry in 1956-7; differences of design in British and continental heating and hot-water service installations.

There is a useful index to the material on heating and ventilating published in 1956 in some 70 British periodicals. There is also a list of relevant British standards.

The trade directory includes a classified buyers' guide, a list of trade name and manufacturers addresses. There is a list of trade and technical associations, and of the members of the Association of Heating, Ventilating and Domestic Engineering Employers who collaborated in the compilation of this volume. (London, Technitrade Journals, 1957. 426p., 12/-.)

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Atomic Energy

Nuclear energy in Britain. Reference division, Central Office of Information, London.

Building Materials

How to design pole-type buildings by D. Patterson. Chicago, American Wood Preservers Institute, 1957, $1.50.

Products of stainless steel for architects and builders. N.Y., American Iron and Steel Inst., 1957.

Canada. Mines and Mining

Facts and figures about Canadian oil. Imperial Oil Ltd., 1957.

Metal and industrial mineral mines in Canada. (Canada, Dept. of Mines and Technical Surveys List 2-1) Ottawa, 1957, 25 cents.

Education

A bulletin on the supply and demand situation in regard to university graduates. Canada. Unemployment Insurance Commission, 1957.

EUSEC engineering education and training. N.Y., E.C.P.D., 1957. $5.00.

Electrical Engineering

Electrical Research Association; Technical reports; F/T190—A further simple method for the calculation of cyclic rating factors and emergency loading for cables laid direct or in ducts by H. Goldenburg. F/T192 — The calculation of external thermal resistance and cyclic rating factors for groups of cables laid direct in the ground or in ducts by H. Goldenberg. L/T348 — Debye losses due to electrons trapped at vacancies by J. A. Sussmann. ST73 — Surge voltage distribution in transformer windings due to current chopping by E. L. White. S/T79 — The surge electric strength of oil impregnated paper wrappings by G. W. Bowdler. S/T80 —Developments in E.R.A. impulse testing technique, by J. L. Miller and E. M. Dembinski. V/T130 — Electronic voltage stabilizers for laboratories computers and control systems by J. Miedzinski and S. J. Zgorski. V/T131 — A network analyser test problem by P. G. Kendall. Z/T114 — An experimental investigation of tooth-ripple flux pulsations in smooth laminated pole-shoes by J. Greig and K. C. Mukherji.

Engineering Abstracts

Bibliography of engineering abstracting services. N.Y., Special Libraries Assoc., 1955, $1.50.

Engineers

Survey of attitudes of scientists and engineers in government and industry. Washington, G.P.O., 1957, 50 cents.

International Geophysical Year

Bibliography for the International Geophysical Year. National Science Foundation, 1957, 20 cents.

The Canadian program for the International Geophysical Year, May 1957. Ottawa. National Research Council, 1957.

Lubrication — Steam Turbines

Symposium on steam turbine oils. (ASTM Special Technical Publication No. 211.)

Metals and Alloys — Cleaning

1957 supplement to the metal cleaning bibliographical abstracts, by J. C. Harris. (ASTM Special Technical publication no. 90-D.) $2.00

Soil Mechanics

The mechanism of flow slides in cohesive soils. G. G. Meyerof. (NRC Technical memorandum no. 50.)

The Nicolet slide. J. E. Hurtubise and P. A. Rochette. (NRC Technical memorandum no. 48.)

Permafrost; a digest of current information. (NRC Technical memorandum no. 49.)

Proceedings of the 3rd muskeg research conference, February 20 and 21, 1957. (NRC Technical memorandum no. 47.)

Strength of Materials

Corrosion fatigue cracking resulting from wetting of heated metal surfaces with special reference to steam power plant. Manchester, National Boiler General Insurance Co. Ltd., 1957.

The non-destructive testing of engineering materials. Middlesex, A. E. Cawkell, 1957.

Viscosity

ASTM viscosity tables for kinematic viscosity conversions and viscosity index calculations. (ASTM stp. no. 43-B) Philadelphia, 1957.

Annual Reports

Atomic Energy of Canada Ltd., 1956-57.

Canada. Crown Assets Disposal Corp., 13th Annual report, 1956-57.

Canada. National Research Council, 40th annual report, 1956-57.

Canada. Northern Canada Power Commission, 1956-57.

ASTM standards on electrical insulating materials.

STANDARDS RECEIVED

ASTM standards. American Society for Testing Materials, 1916 *Race St., Philadelphia* 3, *Pa.*

W55.2—1957: Specification for resistance welding practice.

ASTM designation B 225-57T. Tentative specifications for copper and copper alloy arc welding electrodes.

Canadian Standards. Canadian Standards Association, 235 *Montreal Rd., Ottawa* 3, *Ont.*

CSA C22.2, no. 11-1957; Canadian Electrical code, part 2, Essential requirements and minimum standards covering electrical equipment.

CSA C49-1957; Specification for aluminum stranded conductors and aluminum conductors steel reinforced, 2nd ed.

Business and Industrial Briefs

A DIGEST
OF INFORMATION
RECEIVED BY
THE EDITOR

Appointments and Transfers

Shawinigan Chemicals — Appointment of R. J. Southwell, president of Canadian Resins and Chemicals Limited, as a vice-president of Carbide Chemicals Company and also of Bakelite Company is announced. Both companies are divisions of Union Carbide Canada, Ltd.

Mersey Paper Company—The retirement of B. J. Waters as president of Mersey Paper Company Limited has been announced, effective July 1st; he will be succeeded by J. H. M. Jones, now vice-president and general manager, who will continue as general manager of Mersey. R. L. Seaborne, M.E.I.C., a vice-president and the woodlands manager of the company, will retire on July 1st also. J. A. Parker, secretary-treasurer, becomes in addition a vice-president.

The Canadiana Company Limited — The Grolier Society of Canada Limited has announced the appointment of the executives of The Canadiana Company Limited, distributors of the new *Encyclopedia Canadiana*, and a division of the Grolier Society: K. L. Brown, vice-president in charge of sales, and continuing as executive editor and art director of the publication; J. A. McBride, vice-president and manager; G. A. Dobbin, sales manager, in charge of recruiting of sales staff and supervision of sales programs across the country.

H. C. Pitcher

Shell Oil — R. C. Wiens has been appointed co-ordinator of management development and training, Shell Oil Company of Canada, Limited, and will make his headquarters in the company's head office in Toronto.

M. W. Kellogg — The appointment has been announced of H. C. Pitcher as construction manager, the M. W. Kellogg, Company, New York, in charge of all Canadian and South American construction for The M. W. Kellogg subsidiaries — The Canadian Kellogg Company, Ltd., Toronto, and Kellogg Pan-American Corporation, New York; he will also be in charge of the construction activities of M. W. Kellogg's fabricated products division.

Canadian Resins and Chemicals — G. M. Hale has been appointed to the newly-created position of vice-president and general manager of Canadian Resins and Chemicals Limited.

Power Corporation Designers & Consultants — The appointment of J. W. Rook as president of Power Corporation Designers & Consultants Limited, Montreal, has been announced; D. D. Dick, M.E.I.C, has been made vice-president and general manager.

Pacific Petroleums — Announced recently was the appointment of C. R. Hetherington as managing director of Pacific Petroleums Ltd., Calgary.

Westcoast Transmission Company — D. P. McDonald has been named managing director of Westcoast Transmission Company Limited, Calgary.

MacMillan & Bloedel — Election of J. V. Clyne, former Judge of the Supreme Court of B.C., to chairmanship of the board of directors of MacMillan & Bloedel Limited, Vancouver, has been announced.

R. C. Wiens

Leland Electric—B. V. Elliot, Q.C., has been elected to the board of directors of Leland Electric Canada Limited.

Ontario Hydro — The following appointments have been announced by The Hydro-Electric Power Commission of Ontario: O. S. Russell, director of the organization services division; W. H. Edwards, manager of the Commission's west central region, with headquarters in Hamilton; F. O. Price, director of frequency standardization.

B.C. Engineering Co. — Announced recently were the following appointments to B.C. Engineering Co. Ltd., the design and engineering firm for B.C. Electric: W. G. Huber, special assistant to the president, T. Ingledow; H. W. Smith, general manager; R. M. Bibbs, assistant general manager; H. W. Peck, executive assistant to Mr. Ingledow; C. H. Maartman, JR.E.I.C., design superintendent of Hydro-electric projects; H. M. Ellis, chief of technical research; R. C. Hausch and F. J. Spook, staff engineers.

Collins Radio Company — J. P. Giacoletto has been appointed general manager of Collins Radio Company of Canada Ltd.

• BRIEFS

Trans-Canada Pipe Lines — C. C. Whitaker, formerly construction supervisor for Trans-Canada Pipe Lines Limited, has been appointed superintendent of operations for the company, and will make his headquarters in Toronto.

Robertshaw-Fulton — The following appointments have been announced by Robertshaw-Fulton Controls (Canada) Limited: F. H. Barker, general sales manager; G. H. Warren, plant manager; P. S. Barkhouse, field service manager.

J. A. Wilson Lighting & Display — The appointment has been announced of V. Labbe to the position of eastern district manager of J. A. Wilson Lighting & Display Limited; Mr. Labbe will be located in Montreal.

Pitney-Bowes of Canada, Ltd. — R. Vanier has been made manager of the Quebec City district office of Pitney-Bowes of Canada, Ltd.

F. S. B. Heward & Co. — B. J. Roffey has joined the staff of F. S. B. Heward & Co. Limited, Montreal; Mr. Roffey will represent Dewrance & Company Limited, London, England, the British principals of F. S. B. Heward & Co.

Barber-Greene — The following two field sales appointments have been announced by Barber-Greene Canada Ltd.; W. H. Worden, field engineer, with headquarters in Calgary; F. G. LeDez, JR.E.I.C., field engineer, with headquarters in Don Mills, Ontario.

B. F. Goodrich — H. S. Alderson has been made manager of B. F. Goodrich Koroseal pipe sales.

Inco Appointments — R. D. Parker, vice-president in charge of Canadian operations of The International Nickel Company of Canada, Limited, will move his headquarters from Copper Cliff, Ontario, to the company's offices in Toronto early in the year. The following Inco appointments have been announced: R. H. Waddington, assistant vice-president of the company and general manager of the parent company, Ontario division; J. C. Parlee, assistant vice-president and general manager of the Manitoba division; R. A. Cabell and P. Queneau, assistant vice-presidents of The International Nickel Company of Canada, Limited, and also vice-presidents of The International Nickel Company, Inc., the United States subsidiary of the company. F. Benard, assistant to the vice-president, will assume the additional position of assistant general manager of Ontario division; A. Godfrey and G. A. Harcourt, assistants


SERCOMBE
DOMINION

to the vice-president, will assume the additional positions of assistants to the general manager of Ontario Division. Promotions announced are as follows: T. M. Gaetz, manager of mines; R. A. Saddington, manager of reduction plants; J. A. Pigott, superintendent of mines; C. H. Stewart, assistant to the manager of mines; H. W. Peterson, assistant superintendent of mines.

W. S. Atkins & Associates—G. G. Hatch has been appointed president of W. S. Atkins & Associates Limited, a firm of consulting engineers having offices in Toronto and Montreal; he was recently plant superintendent of the Quebec Iron and Titanium Corporation, Sorel, Que.

Neptune Meters—It was recently announced that W. O. Randall has been appointed vice-president and general manager of Neptune Meters Limited and Neptune Patterns Limited.

Goodyear Appointments—The following appointments have been announced by The Goodyear Tire & Rubber Company of Canada, Ltd.: D. S. Hewitt, acting manager, Central Ontario division, with headquarters in Toronto; W. M. Ecclestone, assistant manager, Central Ontario division.

Practor & Redfern — E. M. Proctor, M.E.I.C., senior partner of Proctor & Redfern, consulting engineers, Toronto, has announced that R. G. Tredgett has become a full partner in the firm.

News of Business and Industry

Refinery Development—Canadian Oil Companies Ltd. announce an $8,000,000 expansion of the company's Sarnia refinery. Built in 1952 to refine 20,000 barrels of crude oil per day, the refinery has already expanded its daily capacity to 30,000 barrels. In order to meet the indicated rise in consumption of petroleum products, a building program to further increase the capacity of the company's refinery to 50,000 barrels per day will be undertaken. The first step will be the erection of a 20,000-barrel per day crude distillation unit, scheduled for completion early in 1959 at a cost of $4,000,000. The remainder of the expansion program is expected to be completed by 1961.

Mold for Large Tire—United Tire Sales have announced the purchase and arrival of a Lodi of California T-98 mold for earthmover and construction tire recapping. This is the first mold of its kind in Ontario and will take over 3 weeks to install at United Tire Sales' newly expanded 45,000 square feet recapping and retreading plant at 33 Tippett Road in Toronto. Imported from California, the huge mold weighs over 68,000 pounds, and is designed to recap tires of all sizes from 44 ins. up to and including the 98-in. diameter tires—regardless of cross sections or rim diameter. The mold is, in effect, flexible—and intended to accommodate today's sizes as well as any new sizes or shapes that may come into use in the future.

Incorporation of Firm—J. Edgar Dion, M.E.I.C., has announced the incorporation of his present firm. Effective December 1st, 1957, the company name is now J. Edgar Dion & Company Ltd.; address, 4643 Sherbrooke Street West, Montreal 6.

Alkon Distributors—The Alkon Products Corporation, 200 Central Avenue, Hawthorne, New Jersey, manufacturers of precision pneumatic and hydraulic equipment has appointed J. B. Morrison Machine Co. Ltd., Toronto, and L. S. Tarshis and Sons Co. Ltd., Montreal, as Alkon stocking distributors in their provinces.

Dominion Bridge Subsidiaries—Dominion Bridge Company, Limited has recently announced that the operations of two of its wholly owned subsidiary companies, Riverside Iron and Engineering Works Limited, Calgary, Alberta, and Sault Structural Steel Company, Sault Ste. Marie, Ontario, will henceforth be carried out under the Dominion Bridge Company name. In both cases, the principal reason for the change is stated to be the widening scope of activities of the subsidiaries concerned.

Canadian Oil Companies, Limited announce that the executive offices and the offices of the Southern Ontario division are now located at Canadian Oil Building, 188 University Avenue, Toronto 1; the telephone number will be EMpire 2-2844.

● BRIEFS

New Office Location — Z. Przygoda, M.E.I.C., consulting engineer, has announced the new location of his office at 7 Sultan Street, Toronto. Services include structural, industrial and town planning engineering.

Plant Expansion—Liquid Carbonic Canadian Corporation Limited and its associated company, Imperial Oxygen Limited, both of which companies have recently been acquired by General Dynamics Corporation, announce plans for a $1,000,000 plant at Weston, Ontario, for a daily capacity of 17 tons of liquid oxygen, nitrogen and argon, a new depot in Windsor, Ontario, at an investment of $110,000, and a new depot in Montreal, at a cost of $60,000.

Exclusive Franchise—Pye Canada Limited has completed negotiations with Utility Tower Manufacturing and Fabricating Company of Oklahoma, Okla. As a result of the negotiations, Pye Canada Limited has the exclusive franchise throughout the Dominion for the products and services of this American company.

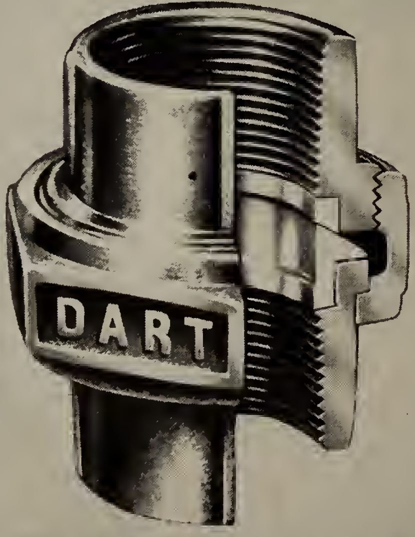
Air Conditioning System Contract—Carrier Engineering Limited has announced the award to the company of a contract with Imperial Life for the installation of an air conditioning system for the 21-storey Imperial Life Tower Building and the 9-storey head office building located on Victoria Street in Toronto.

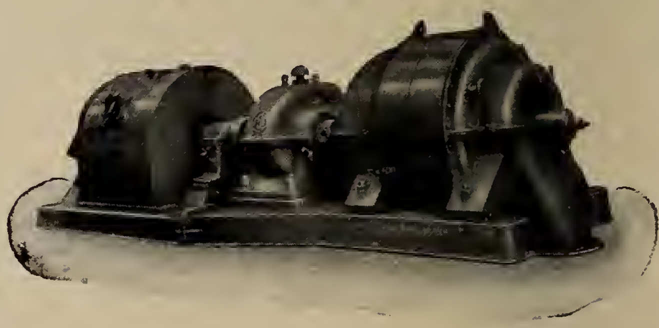
Copper Price Change—In view of the Canadian-U.S. dollar exchange rate, International Nickel has adjusted its price for Canadian domestic copper deliveries to 25.875 Canadian cents per pound delivered Toronto. This price corresponds to the published 27 cents U.S. price for primary copper.

C.I.L. Expansion—The latest unit in a three-year expansion program at the Cornwall works of Canadian Industries Limited and its associated company, Cornwall Chemicals Limited, has been completed and is now in commercial production. The new unit, a plant producing carbon tetrachloride, is an addition to the facilities of Cornwall Chemicals Ltd. The unit uses the only process of its kind in Canada and is the second carbon tetrachloride plant in the country.

The plant is a three-storey building of structural steel with sandwich-type asbestos corrugated board siding and fibre glass insulation. An overhead sprinkler system throughout the operating areas and additional equipment comprise the fire protection system. An elaborate ventilating system is capable of completely changing the air in the entire building in five minutes. Because of the nature of the chemicals used, reaction vessels are made up of several types of metal such as nickel, Inconel and stainless steel. Much of the equipment is glass lined and Pyrex glass piping is used extensively.

Federal Public Works Contracts—Public Works Minister Howard Green has announced that contracts involving expenditures totalling $5,228,449.00 were awarded by the Federal Department of Public Works during the month of September, 1957. The amount for new works in building construction and harbours and rivers engineering is $2,737,173.45; for the repair and maintenance of existing structures $586,157.15; for dredging $73,304.40; and for construction of Trans-Canada Highway and other roads in National Parks, $1,831,814.00. Contracts involving expenditures totalling $4,951,036.26 were awarded by the Federal Department of Public Works during the month of October, 1957. The amount for new works in building construction and harbours and rivers engineering is $1,837,281.26; for the repair and maintenance of existing structures $699,095.00; for dredging $2,165,760.-





00; and for construction of Trans-Canada Highway and other roads in National Parks $248,900.00. During the month of November, 1957, contracts involving expenditures totalling $1,664,124.00 were awarded by the Federal Department of Public Works. The amount for new works in building construction and harbours and rivers engineering is $1,477,799.00; and for the repair and maintenance of existing structures $186,325.00.

New Equipment and Developments

A New Construction Material — Rosco "V-V Protected" roofing, siding and insulated panels are exclusive products of Rosco Metal & Roofing Products Ltd. They are produced under an agreement with Heaman Paint Co., Ltd. the manufacturers of Vinsynite in Canada. The new line of Rosco "V-V Protected" corrugated sheets and fabricated panels is available in a variety of colours in highly durable factory coated vinyl plastic finishes manufactured entirely from Canadian materials. This multiple protection is welded to the base metal through the use of Vinsynite.

Vinsynite provides an unequalled base for additional top coats that are selected for long term weathering. The complete system adds many years to the life of the formed metal sheet.

Chain Saws — Two new chain saws have been introduced by McCulloch Company of Canada, Toronto. Said to be 20 per cent more powerful than previous models, the two new saws also feature improved cooling, longer life and easier maintenance. The McCulloch Super 44 produces 6.5 horsepower and weighs only 19 pounds. Its gear-driven companion, the McCulloch Super 55, produces 6.5 horsepower and weighs just 22 pounds.

New Impulse Monitor — A new impulse monitor which automatically provides for shutting down an electric salt bath heat treating furnace in the event of control instrument or relay failure has recently been introduced by Canadian General Electric Company Limited. Not subject to the shortcomings of conventional safety controls using thermocouples or other heat-measuring devices, the impulse monitor responds to the duration of the energy input feeding the furnace. The monitor is set manually. Timing devices offer two ranges, either from 0 to 240 minutes, or from ½ to 30 hours. Should the power input to the furnace continue longer than the time selected, the monitor first endeavours to shut off the power. Failing in this because of fused contact tips or similar trouble, it then signals an alarm over telephone lines, lights, bells or other protective devices. Separate contacts provide for whatever external alarm system is desired.

Incandescent Lighting — The new Inca-Light line of incandescent lighting by J. A. Wilson Lighting and Display Limited offers a modern concept for both commercial and residential applications. Available in four shapes and three sizes, the Inca-Light glassware is moulded from high-efficiency, single layer glass. A completely new glass collar design provides a five inch wide standard reinforced opening for all shapes and sizes. Both the close-up holder and the 6 in. or 18 in. pendant hangers are finished in chrome or brass. The 'Lev-R-Lok' holder is self-locking and assures absolute safety in glass retention.

There is a simple order form on page 163 of this issue.

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MEMBERSHIP

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Indexed in The Engineering Index

(19,650 copies of this issue printed)

MEET THE AUTHORS

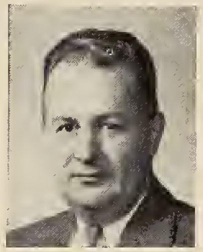
S. D. Lash, M.E.I.C. Head, Civil Engineering Department, Queen's University, Kingston, Ont. *(Planning of Recent New Towns in Canada.)* Dr. Lash is an honours graduate, University of London, and Ph.D., University of Birmingham. He came to Canada in 1929 and worked for engineering firms in Montreal and Vancouver before becoming an instructor at the University of B.C. In 1938 he joined the National Research Council, where he was later acting secretary of the National Building Code project. Dr. Lash joined the staff of Queen's University in 1941. In 1942 he was awarded the Gzowski Medal of the E.I.C.

O. W. Titus, M.E.I.C. President, Canada Wire and Cable Co. Limited, Toronto. *(St. Lawrence Estuary Submarine Power Transmission System.)* Graduated from University of Toronto (B.A.Sc., Elec.) and became a demonstrator there in 1919. After considerable experience in the electrical industry, becoming chief engineer of Canada Wire and Cable, he was appointed vice-president and director of the English Electric Company of Canada in January 1948. In May of that year, Mr. Titus became general manager of Canada Wire and Cable, a director in 1954, and president in 1957. He is president and a director of Telecables & Wires Limited. Mr. Titus is also a prominent member of many technical associations, institutes, and committees, member of Senate, University of Toronto, and member of council, Toronto Board of Trade. He is the author of several papers.

R. Patterson. Technical Manager, Small Arms Division, Canadian Arsenals Limited. *(The F.N. Rifle.)* Mr. Patterson has been associated with the small-arms field since joining the John Inglis Company (Ordnance Division) in 1938, where he took part in the study of British production methods in preparation for the manufacture of Bren guns in Canada, and was engaged on their early production. During the war years he was engineering and inspection manager in Canada, working on many Government contracts. In 1946 Mr. Patterson transferred to Canadian Arsenals Limited in his present capacity.

W. Goldstern. Director, Steam Storage Co. Ltd., Leeds, England, and Toronto. *(Important Applications of Heat Storage in Industry.)* Mr. Goldstern graduated from the Technical University, Munich, in 1928 (mechanical engineering). For some years he worked with Dr. J. Ruths, inventor of the steam accumulator, and became a consultant in 1940, specializing in fuel economy and heat storage. Mr. Goldstern founded his present company in 1948, in Leeds, and established the Toronto branch in 1957, in co-operation with Dominion Bridge Company Limited. He has published a book on steam storage; heat charts of V.D.I. (German Engineers Association); and three series of fuel saving charts. He has also patented an external charging device.

M. A. Scheil



G. E. Fratcher

Four co-authors, Messrs. M. A. Scheil, G. E. Fratcher, S. L. Henry, and E. H. Uecker (all of the A. O. Smith Corporation, Milwaukee, Wis.) contributed to the papers *Brittle Fracture in Steel as Related to Flash-Welded Line Pipe* and *Low-Temperature Burst Tests of Flash-Welded Line Pipe,* which are parts II and III of a series. Part I (*Manufacture and Metallurgy of Flash-Welded Line Pipe)* was published in the February 1958 issue of the *Journal*, together with biographical sketches of the authors.

S. L. Henry

E. H. Uecker

COVER PICTURE

A two-thousand-foot-long dam will back up the Cheakamus River, some 65 miles north of Vancouver, to form a 1,060-acre storage basin to provide year-round water for B.C. Electric's Cheakamus hydro-electric station. Water is carried by a 6.7-mile tunnel through Cloudburst Mountain to the power station on the Squamish River.

Photo: B.C. Electric Company

Planning of Recent New Towns in Canada

S. D. Lash, M.E.I.C.
Head, Department of Civil Engineering, Queen's University, Kingston, Ontario

Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June, 1957

Many new towns have been started in Canada during recent years. This paper is concerned primarily with new industrial towns in rural or undeveloped areas. The organization and planning of such towns has been based partly on previous Canadian experience with company towns and partly on British experience in building garden cities and "New Towns".

The plans of some of these towns are discussed firstly in terms of general structure and then in connection with the arrangement of streets. The planning of town centres is briefly considered. Some consideration is given to general problems of site engineering. The paper concludes with recommendations for the establishment and planning of future new towns.

One of the consequences of the rapid development of Canada since the war has been the construction of a considerable number of new towns located for the most part in previously undeveloped areas. The planning of some of these towns is the subject of the present paper. No attempt has been made to provide a complete record of what has been done. The author has tried to discuss the principles involved in building new towns and to illustrate these principles by examples taken from recent Canadian experience.

The Company Town and the Garden City

From the early nineteenth century industrial development in North America has often taken place in areas remote from existing towns. This has resulted in towns planned and built by industry so as to provide housing for their workers. Such towns are commonly referred to as "company towns" or more generally as "single enterprise communities".[1]

The degree of control exercised in the town by the company has varied considerably. In its most complete form the company owns all the land including the roads and may therefore limit public access to the town: it owns the houses and may require workers to buy at company stores. There is no democratic local government. Although such "closed company towns" are not unknown in Canada, they are few in number and relatively unimportant. More common is the company town to which the public has free right of access and in which private stores are permitted. A substantial proportion of the houses are company owned, but private building is also permitted. There may be an elected municipal council though the relations between the council and the company are often rather delicate. Some times the company town is deliberately planned as a "model community".

Company towns are essentially the product of a private enterprise system. Until recently, government has had little to say about the planning and development of company towns though it has sometimes faciliated their establishment by making land available at low cost. Such towns, by reason of careful planning combined with some attempts at town design, are frequently quite attractive especially in comparison with unplanned communities. In the United States, company towns have acquired a bad reputation. At the best they are considered unduly restrictive of human liberties and at the worst they are regarded as a tool for the control and exploitation of labour.

On the whole, experience in Canada with company towns has been good. Nevertheless they are seldom popular. The workers prefer a freer environment; the industrialist dislikes the diversion of capital and effort required to build a town and recognizes that being a landlord makes for poor labour relations; governments regard such towns with suspicion as being at least temporarily beyond the pale of ordinary municipal government. A further difficulty in Canada is that company towns associated with primary industry such as mining may have a very short life before they finish up as "ghosts".

Possibly the first example of government planning of a new industrial town occurred at Kapuskasing. This resulted from an agreement in 1921 between the Government of Ontario and the Spruce Falls Company in which it was stated that "the Government is desirous of creating a town and having same planned and developed on model lines." The planning and laying out of the townsite and all other work connected therewith was done entirely by various officials of the Ontario Government.[2]

Within recent years Ontario and Alberta have taken definite steps to discourage the establishment of any more company towns particularly on crown land. One official has said "The Province (of Ontario) has indicated that they do not like company towns and they're going to do everything they can to stop the development of company towns".[3] The Mining Act as amended in 1954 provides that the surface rights of mining claims may be reserved by the government through Order-in-Council for the purpose of developing townsites. The New Towns Act of Alberta[4] provides that the Lieutenant Governor in Council upon the recommendation of the Provincial Planning Advisory Board may "declare such a town is governed by a Board of Administrators created by the Lieutenant Governor in Council" who are required to submit "comprehensive proposals for the planning and orderly development of the new town".

In Manitoba the Lieutenant Governor in Council has power to incorporate as a "local government district" communities in unorganized territories adjacent to a place where mining or other industrial operations are being carried on.[5]

In Quebec "No holder of a mining license can develop a mining town, or even a semblance of a few buildings as a mining town without the control of the Government. The Minister of Mines in co-operation with that of Municipal Affairs decides what is to be done".[6, 7]

In British Columbia, although a number of successful company towns have been built in the past, the present policy is to incorporate new communities as municipalities at a very early stage in their development.

It seems clear that nobody really loves the company town and it is not surprising therefore that encouragement is being given to other ways of building towns in primitive areas. The "New Town" is the most promising of these ways.

The "New Town" is essentially a development of the "Garden City" idea proposed by Ebenezer Howard in England in 1898 and first put into practice at Letchworth Garden City in 1904. A "Garden City" is defined as follows:

"A Garden City is a Town designed for healthy living and industry; of a size that makes possible a full measure of social life but not larger; surrounded by a rural belt; the whole of the land being in public ownership or held in trust for the community."[8]

A number of garden cities were built in England and elsewhere and these served not only to demonstrate the essential soundness of Howard's ideas but also to test out new concepts of physical planning. These concepts included "use and density zoning, a form of ward or neighbourhood planning, employment of an agricultural green-belt to control urban size."[9]

The financial difficulties inherent in building garden cities with limited capital resources, showed that Howard's ideas could only be put into practice on any substantial scale with government support. The British "New Towns Act" passed in 1946 made the building of new towns an important activity of the government of the country. At the end of 1956, construction of 15 new towns with a total ultimate population of 685,000 was under way and 321,000 people were already living in these towns. The success of this large scale experiment both from a social and a financial standpoint appears to be assured.

In Canadian new towns we can recognize these two major influences—the company town and the garden city. Administratively, the new town is the alternative to the company town and it comes into being when "the existing system of local government cannot cope with the problems brought on by a very rapid rate of growth".[10] As a result of the experience gained in building garden cities it is now possible to plan detached industrial communities on virgin sites so that the inhabitants may enjoy a full social life amidst pleasant and healthy surroundings.

Table I lists the principal new towns started in Canada since 1945*.

Many Canadian new towns are being built in primitive areas a long way from the big metropolitan cities and are the direct consequence of mining or industrial activity. Kitimat (British Columbia) and Elliot Lake (Ontario) are examples of this kind. Others, such as Aklavik, Frobisher Bay, and Great Whale River are primarily attempts to deal with some of the problems created by the im-

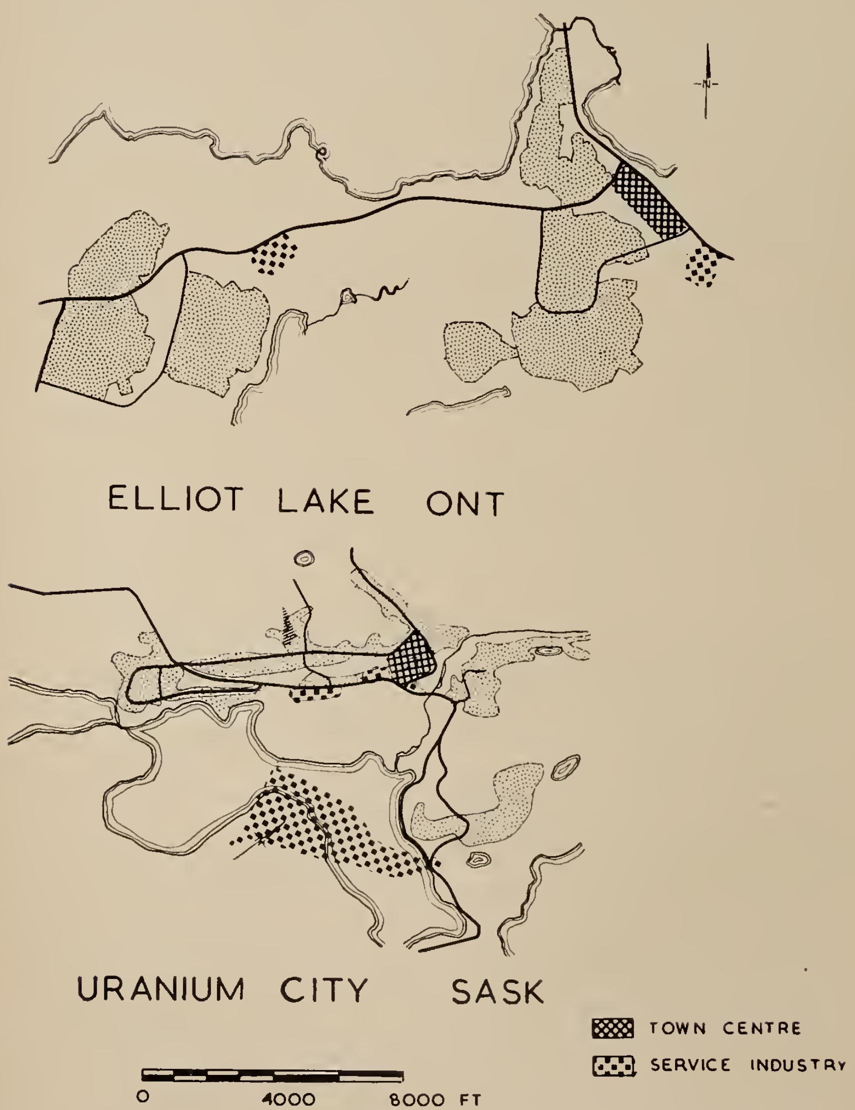


Fig. 1 (top). Elliot Lake, Ontario. Fig. 2. Uranium City, Sask. (General plans.)

*For a more complete list, reference may be made to "Single-Enterprise Communities in Canada", Institute of Local Government, Queen's University, Kingston, published by Central Mortgage and Housing Corporation, Ottawa.

pact of current events on native peoples. Some, for example, Devon (Alberta) and Ajax (Ontario) are primarily satellite towns. Finally, there are large carefully planned real estate developments located within metropolitan areas. An outstanding example is Don Mills (Toronto). It can also be argued that some of the larger military establishments, such as Gagetown (New Brunswick), are in fact "new towns". However a military camp presents many planning problems quite different from those of ordinary towns. This study is confined to new towns having an industrial base and located in primitive or rural areas.

The Beginning

A new town comes into existence as a result of a decision to build a new town. It does not just happen. The decision may be made by an industrial company which needs housing, by a real estate company which hopes to make a profit or by a government whose primary concern is to stimulate seemly development.

It has already been stated that there are serious objections to single, private, ownership of town sites and consequently there is much to be said for government sponsorship. In this way professional planning of the town can be ensured and adequate financing of the town in its early stages can be arranged. Experience has shown that the large initial capital expenditure required for new towns is the greatest single obstacle to their establishment. Roads and utility services have to be paid for before there is a tax revenue to pay for them. In Great Britain, government advances to 14 new town corporations for capital expenditures amounted to £140 million by 31 March 1956.

The New Towns Act of Alberta provides that the government may grant or loan up to $1,000,000 to aid in establishing a new town. In Ontario, the provincial government made the sum of $600,000 available for the establishment of the new town of Manitouwadge. A willingness on the part of governments to make capital advances is an essential feature of an effective new town policy. So far Ontario and Alberta are the only provinces who have established this as a definite policy. A town which is sufficiently capitalized in this way can,

(*a*) make adequate engineering studies as to the general location of

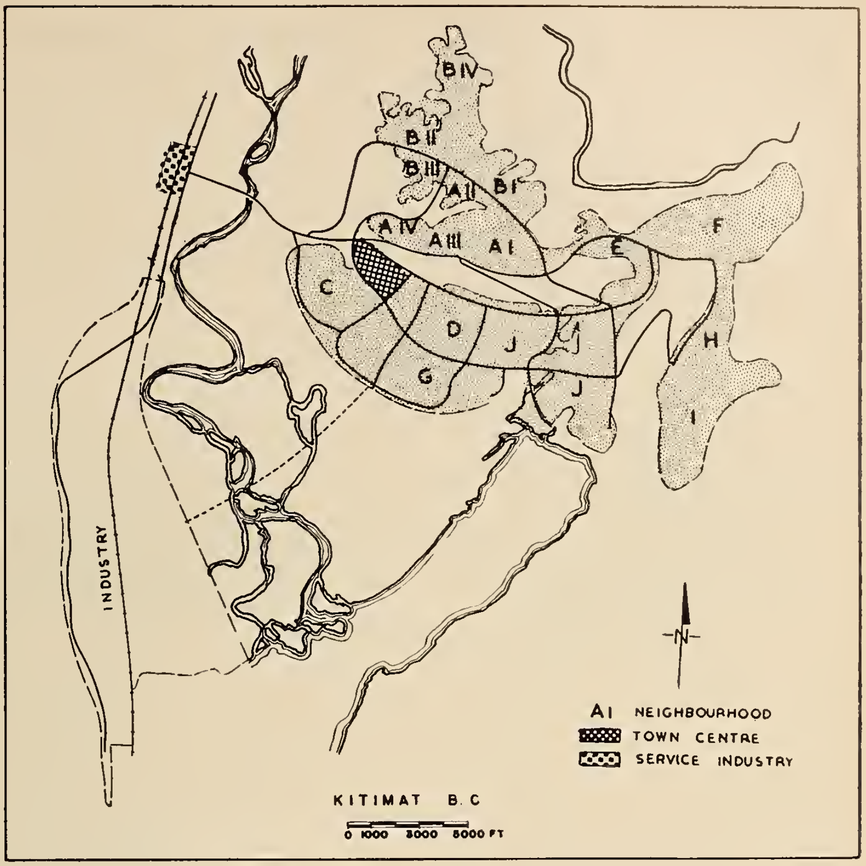


Fig. 3. Kitimat, B.C. — general plan.

Table I.—Principal New Towns in Canada 1945-57

Province	*Town*	*Major Industry or basis of town*	*Authority responsible for initial development*
Newfoundland	Gander	Airport	Government of Canada
Quebec	Chapais	Mining	Opemiska Copper Mines Provincial Government
	Chibougamau	Mining	Provincial Government
	Murdochville	Mining	Gaspe Copper Mines
	Schefferville	Mining	Iron Ore Co. of Canada
Ontario	Ajax	Satellite town	Government of Canada
	Atikokan	Mining	Steep Rock Iron Mines
	Deep River	Atomic Energy	Government of Canada
	Elliot Lake	Mining	Provincial Government
	Manitouwadge	Mining	Provincial Government
	Marathon	Pulp and paper	Marathon Paper Mills of Canada
	Seaway towns	Relocated towns	Hydro-Electric Power Commission of Ontario
	Terrace	Pulp and paper	Longlac Pulp and Paper Company
Manitoba	Lynn Lake	Mining	
Saskatchewan	Uranium City	Mining	Provincial Government
Alberta	Cynthia	Oil	Provincial Government
	Devon	Oil	Imperial Oil Company
	Drayton Valley	Oil	Provincial Government
	Hays	Regional Centre	Prairie Farm Rehabilitation Agency
	Hinton	Oil	Provincial Government
	Lodgepole	Oil	Provincial Government
British Columbia	Kitimat	Aluminum	Aluminum Co. of Canada
Northwest Territories	Aklavik	Regional centre (relocation)	Government of Canada
	Frobisher Bay	Regional centre	Government of Canada
	Great Whale River	Regional centre	Government of Canada

the town and of its principal utility services,

(b) build utilities such as sewers, sewage treatment plants in advance of need thus avoiding for example the wasteful practice of installing septic tanks only to find them unsatisfactory after a few years,

(c) build satisfactory paved roads as required or in advance of need thus avoiding the extensive use of gravel roads which are often quite

known that the population of a mining camp has different characteristics from that of an older town. It differs particularly in age and sex distribution and in cultural values. These considerations as they affect Elliot Lake have been discussed recently by Hall[11] and Phillips.[12]

Hall points out that initially the population is distressingly mobile, employers reporting labour turnovers of from 15 to 50 per cent per month.

or eighty prisoners were shipped by bus each week from Blind River to Sault Ste. Marie, a distance of 85 miles, for trial because the local jail could not hold them.

If the industry becomes established on a permanent basis, a more conventional population structure may be expected to emerge at Elliot Lake. Only when this happens will the town begin to take shape and develop a coherent social structure.

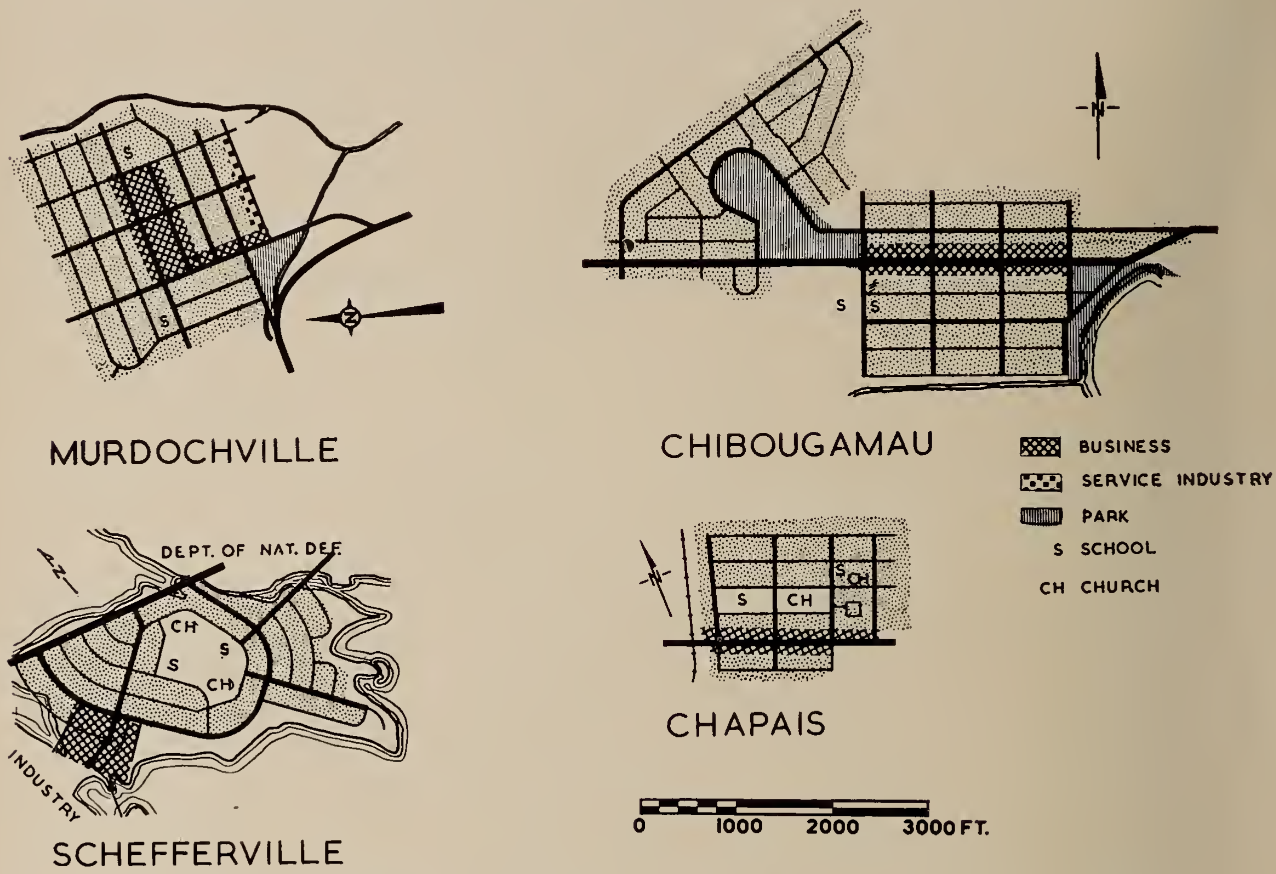


Fig. 4. New towns in Quebec; (a) Murdochville. (b) Chibougamau, (c) Schefferville, (d) Chapais.

unsuitable as urban streets.

In general, advances to establish new towns are in the form of capital loans. These may be repaid by the sale of lots or they may be gradually recovered from tax revenue including taxes on industry.

Economic and Social Base

The new towns we are discussing have mostly come into existence as a result of industrial development much of which is in the form of primary industry. Past experience in Canada suggests that such industry may not provide a sufficiently stable basis for a permanent modern town. In most places secondary industries are unlikely. It seems inevitable therefore that some Canadian new towns must have the characteristics of mining camps rather than towns. It is well

Employment is almost exclusively male and so far there is a lack of suitable housing for married men. It is probable that mill workers will be mostly French-speaking Canadians whereas mine workers are most commonly recent immigrants, many from Italy. There are no old people and relatively few children.

A group of this kind does not appear to provide a sound basis for the establishment of a new town and it creates acute problems for the neighbouring town of Blind River. A "well planned" modern town seldom provides for the "disreputable activities which are typical of recreation and leisure in a modern community" and as a consequence a peripheral town becomes a sort of "moral garbage heap for the planned community". Thus, in 1956 seventy

A further problem in any new development is that of providing temporary housing accommodation for construction workers and others. This must be done in such a way as not to prejudice the development of a more permanent community.

Location

There is often a considerable freedom of choice of site for a new town in a primitive area. Whilst it must be reasonably close to the industry providing employment it need not be on top of it and if the industry is of a noxious or hazardous character may have to be separated from it.

Taylor[13] has described in some detail the considerations affecting the location of Elliot Lake. Briefly these were as follows:

(a) Geology—location of ore zones

of proven ore potential, depth and physical characteristics of the soil overlaying the bedrock, areas of unstable physical form.

(b) Topography — delineation of areas of low to moderate slope and uncomplicated surface form.

(c) Water Resources—definition of drainage basins, stream flow and water quality.

(d) Transportation — highway location, possibility of port development on Lake Huron.

(e) Power distribution.

(f) Land ownership patterns.

(g) Distribution and extent of employment sources.

The preceding studies covered a wide area and led to the conclusion that the area immediately south of Elliot Lake was the best townsite available. Further detailed studies were then made of this area to confirm the information collected previously and to provide the basic information needed to plan the new town. In all preliminary studies of town sites airphoto interpretation has proved to be a most valuable tool. It may be mentioned for example that the preliminary plan of Uranium City is based almost entirely upon studies of this kind.

Although there is infinite space for towns, good town sites are often hard to find especially in the Laurentian shield. The prevalence of lakes, muskeg, and rock, and the relative absence of sand and gravel deposits make it difficult to locate town sites of sufficient size. In some instances the town sites are unduly confined and expansion will be difficult (See for example, Schefferville, Quebec, Fig. 3). In others, towns tend to be fragmented into a number of separate parts. This is shown by the plans of Kitimat, Elliot Lake and Uranium City (Fig. 1 and 2).

These "sub-towns" create difficult problems for the planner more particularly in terms of their social structure. The two parts of Elliot Lake appear to be approximately equal in size and rank and they are two miles apart. Although "twin cities" are not uncommon this is possibly the first occasion when a town has been deliberately planned that way. At Kitimat one suspects that the upper classes will live on the higher ground and the lower orders down below. This of course tends to be the natural order of things, as can well be seen in Montreal, Vancouver, and Banff but the sociologists are not in agreement as to whether such a situation should be deliberately established in a new town.

Size and Structure

According to the definition of a garden city quoted previously, such a town is of limited size and surrounded by a rural belt. The idea that a town should need any provision for a rural belt is at first glance fantastic for a town located in any undeveloped part of Canada, but in point of fact it is only in this way that undesirable fringe development can be prevented. The typical Canadian town in new and old areas alike is partially surrounded by shacks. These can be kept at a distance, though not necessarily prevented by a rural or green belt of sufficient width.

In the case of the Ontario new towns the municipal boundaries are twelve miles square and the policy has been adopted of building one town to serve mines scattered over a

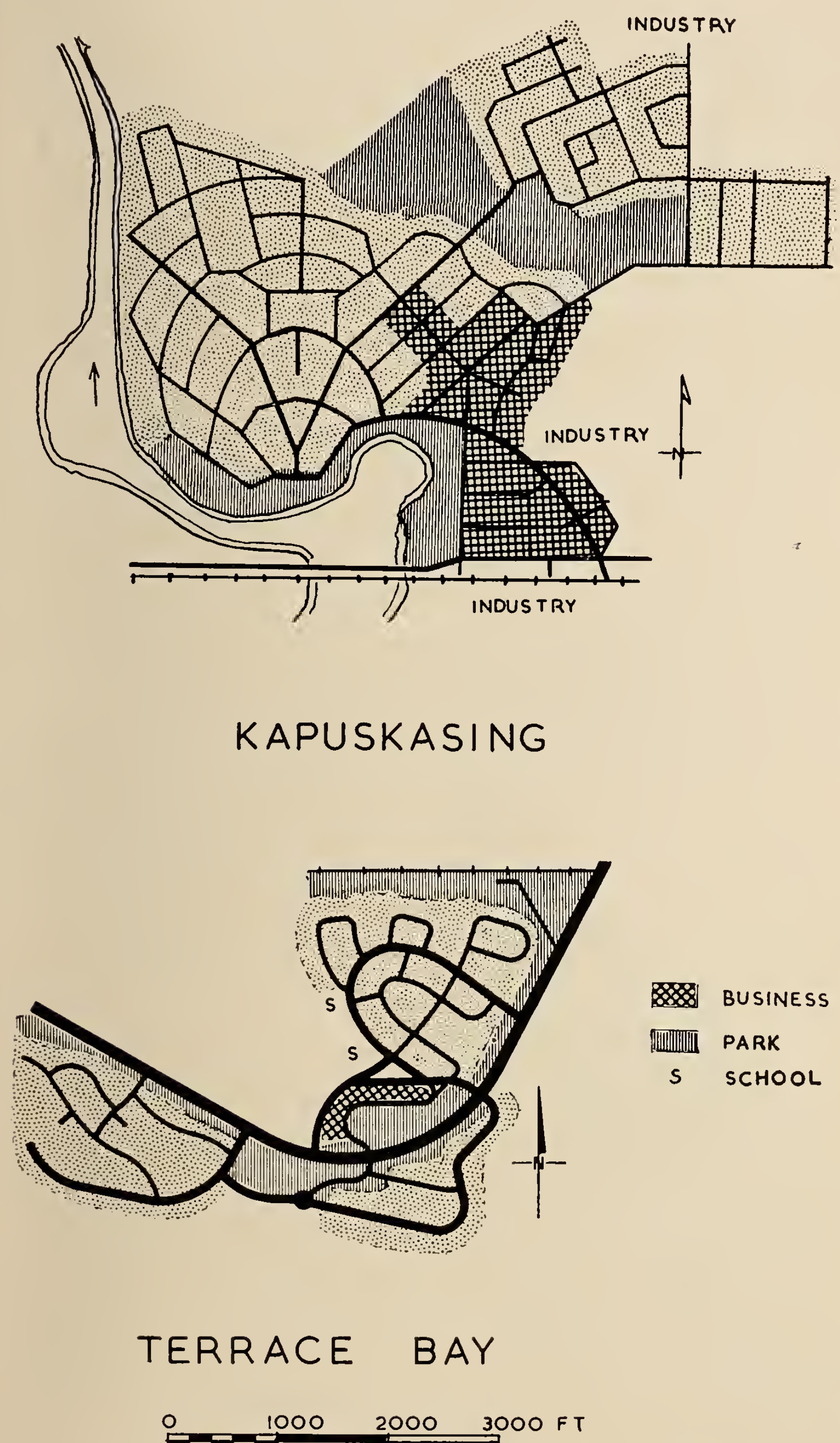


Fig. 5. New towns in Ontario: (a) Kapuskasing, (b) Terrace Bay.

considerable area. In the Pembina area of Alberta several small new towns (Cynthia, Lodgepole, Hinton, and Drayton Valley) are being built within an area about 20 miles square. The decision as to the size of a new town and the overall settlement pattern should be based upon adequate regional studies. Regional planning, in this sense, is in its infancy not only in Canada but throughout the world. It would appear to be further advanced in Alberta and British Columbia than in most other places.

There has been much discussion about the value of the "neighbourhood" as a town planning concept. Much of this discussion arises from a lack of a generally accepted definition. For some, a neighbourhood is essentially a residential area tributary to an elementary school; for others, it is a more or less self-contained small town which in turn is part of a larger town.

The latter concept has influenced the design of new towns in England. These are planned to have neighbourhoods with a population of from 5,000 to 10,000, each neighbourhood having schools, churches, shops, parks, community buildings and so forth. It is intended that the neighbourhood include both rich and poor who would regard themselves as members of the neighbourhood community. A typical neighbourhood would have several schools. The American concept was based essentially upon a single school and community centre and has therefore tended to be smaller, though the neighbourhoods planned by Stein at Radburn, N.J., were intended to have populations from 7,500-10,000. Langlois[14] has suggested that the neighbourhood in a new town having a severe climate should be limited to about 1,000 persons thus reducing the walking distance to school and to local shops. Schools would be planned for not more than 100 pupils and would have an intimate quality lacking in most larger schools.

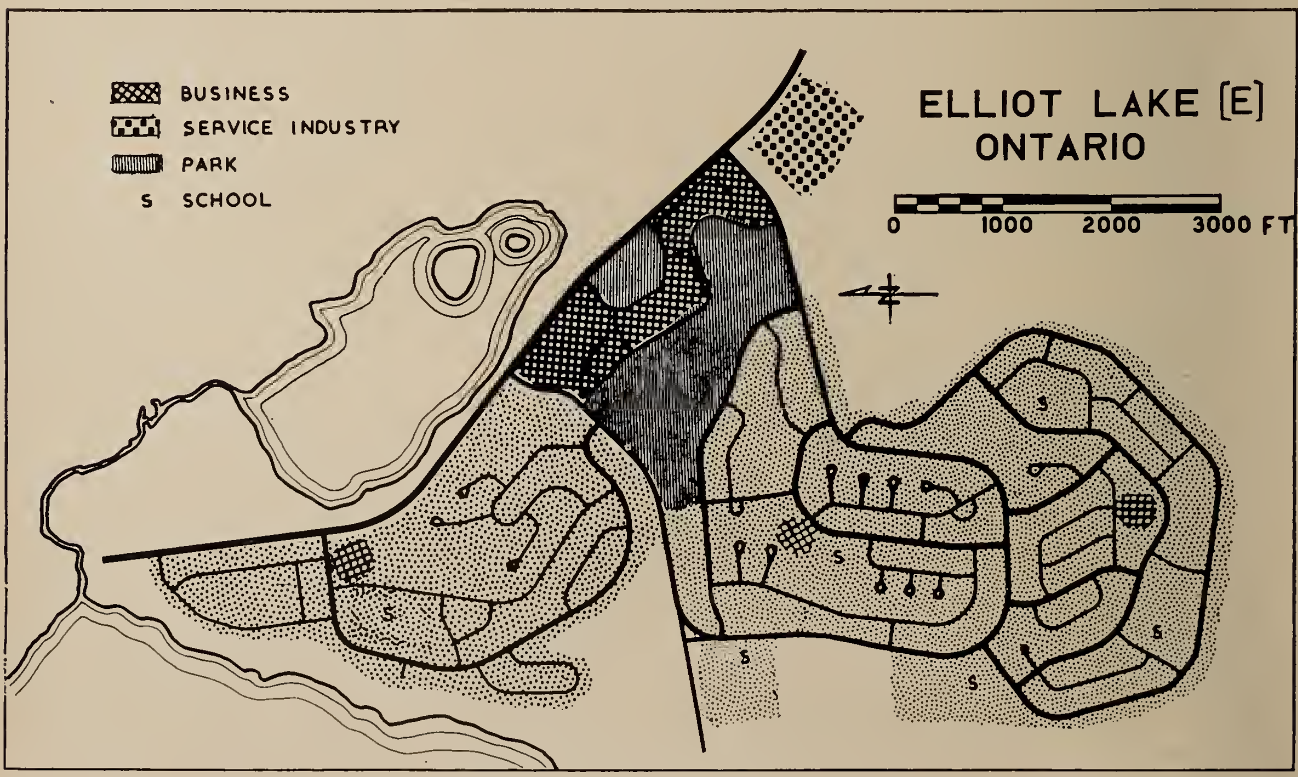
The neighbourhood concept has recently been re-examined by Rasmussen.[15] He concludes "that the idea of the metropolis divided up into small, self-containing units, within which people of all classes live a harmonious and full communal life, is a lovely dream. It can only be a reality for children". Considering the needs of children he says "well arranged towns are much less suitable for children than a small, old-fashioned provincial town with its odd mixtures of workshops, small industries, private gardens, shopping street . . . and a hundred other places that all appeal to a small person's imagination and interprise". He concludes that "the metropolis should be a richly differentiated pattern of small and large units woven into each other, clearly articulated and as rich and complex as life itself". The Canadian new town that approaches this concept most closely is Kitimat. Here there will be twelve neighbourhoods ranging in population from 1200 to 6000, each having one or more schools plus neighbourhood shopping and social centre. At Elliot Lake seven neighbourhoods with populations of the order of 3,000-4,000 have been planned.

In the more restricted sense most new towns reflect some attempt at neighbourhood planning. Commonly this takes the form of a school situated near the centre of a neighbourhood and a street pattern such that children do not have to cross major traffic arteries on their way to school. There has been no attempt except at Kitimat to carry this idea through to the extent of providing a separate system of paths.

One important practical advantage of the neighbourhood unit is that it leads to a proper programme of construction. One or more units can be built as the need arises and an efficient and compact town exists at all times.

In an interesting book Egli[16] has discussed the relationship between climate and the form of towns. He suggests that the kind of town appropriate for a temperate climate is not well suited to a sub-arctic one and implies that with the settlement of sub-arctic areas a distinctive kind of town may emerge. Egli goes on to say "No new town structures con-

Fig. 6. Elliot Lake, Ontario — street plan.



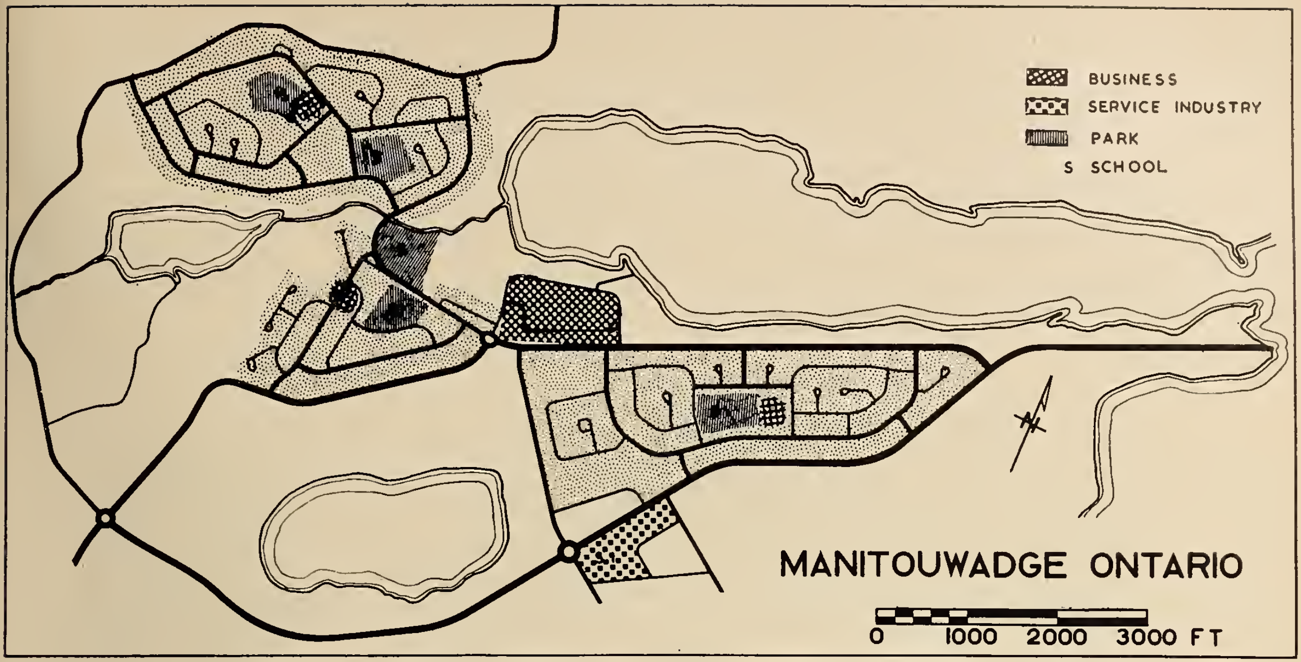


Fig. 7. Manitouwadge, Ontario — street plan.

ceived and developed from their immediate surroundings have as yet been found at all either in the arctic or the sub-arctic zone. This is a great climatic zone that has hardly a sign of authentic creativeness to show, at least in town planning."

An examination of the plans of Canadian new towns supports this view. They all appear to follow the urban patterns developed in more temperate climates. Such differences as do occur, as for example between the plans of Kitimat and Elliot Lake, reflect the preferences of their designers rather than the climatic differences between the coastal region of northern British Columbia and northern Ontario. This lack of sensitivity to environment may be partly a result of inexperience in planning and building new towns and partly a sign of the tendencies to conformity and mass consumption characteristics of our age. The northern town has yet to find its soul.

Street Plans

The street plans of Canadian new towns are of various types (Figs. 3-9). The oldest sort of plan—the grid—still has its adherents, especially in Quebec (see plans of Chapais and Murdochville, Fig. 4); the formal radial plan may be seen at Kapuskasing; the "can of worms" plan at Terrace, and the "superblock" at Kitimat. No simple name has yet been devised for the kind of plans used for the Ontario and Alberta new towns but these resemble the plans of the English Garden Cities and New Towns.

A good street plan has the following characteristics:

(1) It provides an adequate system of major roads so that travel by automobile from one part of the town to another is rapid and safe.

(2) It provides attractive residential streets in which traffic is kept to a minimum.

(3) Adequate space is provided in the central business district both for traffic and for parking.

(4) The plan is such that utility services can be installed economically.

(5) The lots created by the street plan, both residential and commercial are suitable for their proposed uses.

(6) The whole plan has a sense of unity and design appropriate to the site—this means that it has individuality and character.

(7) The plan recognizes the importance of land uses other than houses and shops.

(8) Maintenance including snow removal is economical.

The grid plan fails to meet almost all of the above criteria. The numerous street intersections make it dangerous; residential streets are monotonous and often used by other than local traffic; there is congestion and lack of parking space at the centre; an excessive amount of land is often devoted to streets; the plan may not fit the contours, resulting in excessive development costs; the plan lacks character. The only advantages are those resulting from simplicity—lower planning and drafting cost, less surveying, greater simplicity of municipal records including assessments. On balance, the advantages are far outweighed by the disadvantages and it seems unfortunate that this obsolete kind of planning is being used in some Canadian new towns. One may surmise that this results from entrusting the planning of such towns to those who lack expert knowledge in this field.

The "can of worms" type of planning—seen in many upper class suburbs and some new towns, is the reaction against the sterility of grid planning. It is essentially romantic and frequently rather impractical. It seems fairly safe to regard it as a fashion that has now passed, for it seems poorly adapted to the facts of life in the Canadian bush.

Formal planning of the Versailles-Kapuskasing kind is also out of fashion and ill adapted to rugged terrain. Nevertheless there may be new town sites perhaps in Quebec or the Prairie Provinces where new classical forms can be evolved. As one writer has said, "Every noble city has been a crystallization of the contentment, pride, and order of the community."[17]

The "garden city" kind of planning is much more difficult to evaluate. As the plan is based on a detailed study of the site and the estimated needs of a new community it must be judged on its own terms. This makes generalizations impossible or at least unwise. Certain aspects of modern planning are however evident simply from looking at street plans. Firstly there are three kinds of streets in towns of any size—minor residential streets, collector streets and major thoroughfares. The latter commonly form boundaries of neighbourhoods and are often divided highways. The streets are likely to vary in width both of right-of-way and paving. The minor residential streets are most commonly loops, though cul-de-sacs are also used. Experience with cul-de-sacs at Kitimat has shown that these are less suitable than loops where snow plowing is necessary. In fact it may be said that any street plan involving sharp curves is likely to involve additional trouble and expense in regions of substantial snowfall.

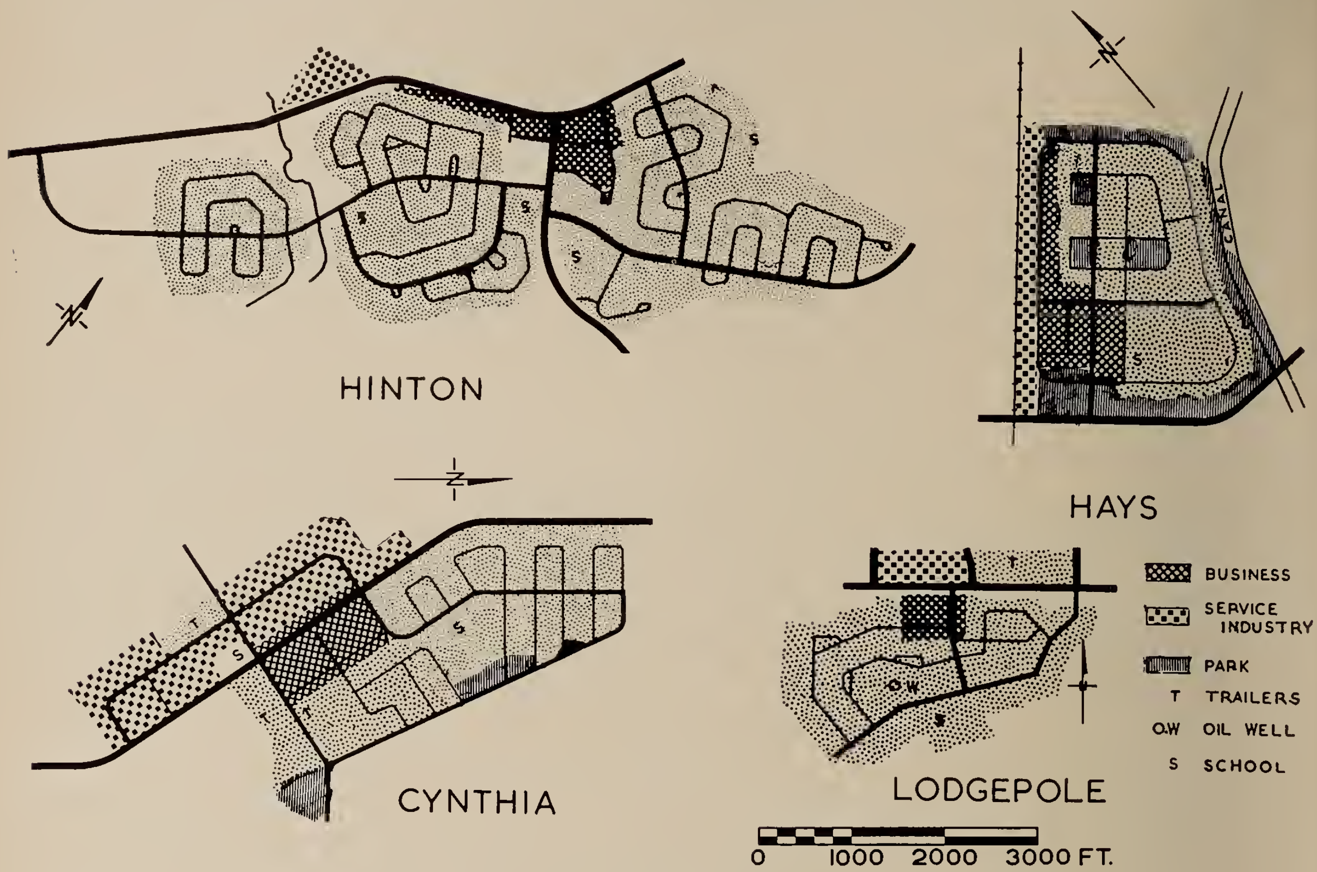


Fig. 8. New towns in Alberta: (a) Hinton, (b) Hays, (c) Cynthia, (d) Lodgepole.

Central Areas

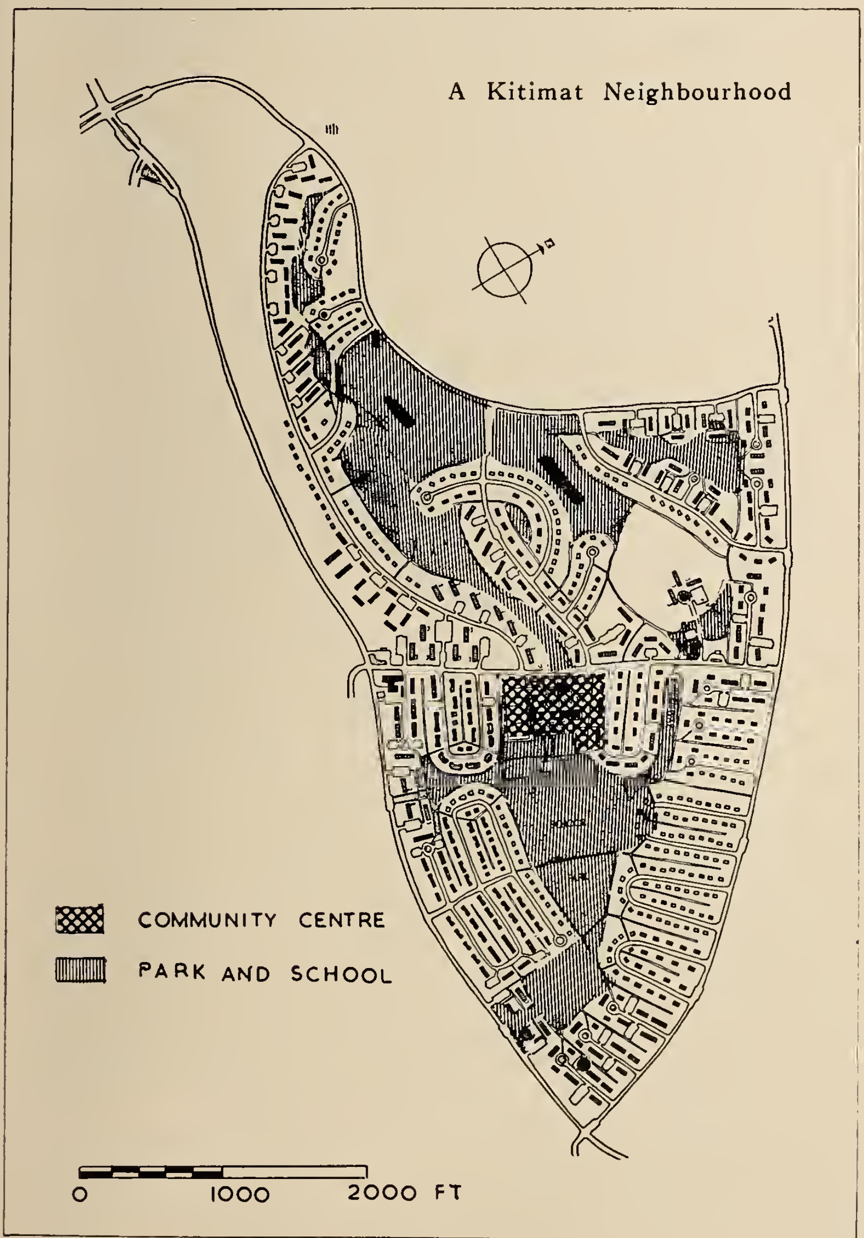
The central area of any town provides the greatest challenge to the town planner. In very small towns the central area is little more than a shopping centre, whereas in larger towns, restaurants, theatres, churches, offices, and government buildings are all important elements of the central area. In Canadian new towns we can see examples of various kinds of central areas. In its simplest and most traditional form the central area consists of "Main Street" as for example at Chibougamau. There is little to be said in its favour. "Main Street" suffers from congestion, lack of parking facilities, lack of protection from wind and sun and a lack of sites for buildings, other than stores. It frequently lacks beginning and end. Much better is the small shopping centre, such as that at Lodgepole (Fig. 10). The traffic on the main road is relatively unimpeded, off-street parking is provided and there is space for people to walk around. As in the traditional English village, a church will be built in proximity to the market place. In the new town of Hinton we can see a somewhat more elaborate centre (Fig. 11). This includes sites for a community recreation centre, a hotel, public buildings and for some high density residential developments. In addition the separate school and the high school are located in close proximity to the centre.

The city centre at Kitimat provides for a hotel, two movie theatres, a library, an auditorium, municipal buildings, office buildings, stores, and parking for 2500 cars. The latter create a very difficult planning problem. The central area is by tradition animated and even congested, with impressive buildings often of considerable height. The modern town centre is in danger of becoming a dreary waste of asphalt paving or parked cars punctuated with low buildings resembling stables. In Canadian towns such as Kitimat and Manitouwadge an attempt is being made to alleviate this situation by landscaping. At Manitouwadge for example "Landscaping was made an integral part of the scheme. To screen the area from the noise and fumes of motors, the parking areas were designed to be surrounded with boulevards of grass, trees, and shrubs. The pedestrian ways were provided with planting areas so that the pedestrian might be afforded shade and protection from the winter winds. The whole landscaping scheme was arranged so that it would be in full harmony with the architectural shapes of the buildings."[18] This appears to be making the best of a bad situation but the problem still awaits solution. Careful planning of a relatively large town centre is evident at Elliott Lake (Fig. 12).

One problem that arises in a new town is deciding when to construct the central business district. In British new towns the tendency has been to delay this construction until there is a sufficient population to justify substantial buildings. In some Canadian new towns the opposite policy has been followed. Business lots have been sold by auction at an early stage in the history of the town for relatively small amounts and inferior buildings have been erected thereon. This happened at Chibougamau. In 1950, the government sold 48 lots by auction for an average price of $2,000 each. By 1955 many of these lots were occupied by second-rate commercial buildings which will have to be demolished later.

This problem was considered in the planning of Kapuskasing in 1921 when it was decided to establish initially a secondary business area where cheap and temporary buildings could be erected and to develop the main business area later. It has not worked out as planned. The secondary area has remained the main shopping centre and what was intended to be the town centre has developed as a residential district. Two observations may be made. Firstly, the supremacy of the central business district should be established as soon as possible; secondly, the land, if publicly owned, should not be sold, if at all, until its true value has been established. It could of course be leased for short periods thus enabling careful control of its use to be made. In this connection a recent study of the economics of the development of Hemel Hempstead town centre may be of interest.[19] (Hemel Hempstead is one of the English new towns.) Land which, including development costs, was worth about £38,000 an acre is now worth from £79,000 to £160,000 and values are expected to rise to a maximum of £250,000 an acre. Many will agree with Professor Robson that "Property and land values which have been created by public expenditure and the efforts of public authorities should not be handed over to private persons or profit-making companies."[20]

Fig. 9. Kitimat, B.C. — neighbourhood plan.



Service Industry

There are many commercial uses that cannot properly be located either in the town centre or within neighbourhoods. These include lumber yards, used car lots, automobile repair shops, warehouses of various kinds, and so forth. In addition there are small industries which may or may not be good neighbours in a residential district. The term "service industry" is commonly used to include both kinds of use. It is desirable to give more thought to the proper location of these commercial and industrial uses than is commonly done. Certainly the practice of permitting a ribbon of these unsightly uses on the main approaches to a town is as deplorable as it is common in Canadian towns. There are signs that this problem has been tackled in some new towns. At Kitimat for example an area for service industry has been reserved well away from other uses but readily accessible to the town centre and the principal lines of communication. Similar areas are indicated on the plans of Elliot Lake and Manitouwadge.

Residential Areas

Most Canadian new towns are based on the assumption that people prefer single-family dwellings, and residential areas are designed accordingly. There can be little doubt that the assumption is correct but one cannot help wondering whether circumstances may not dictate a greater use of multiple-family dwellings including row houses. These factors include: *(a)* the high costs of site development, *(b)* high building costs, *(c)* severe climatic conditions. In this connection it is significant that the plans for neighbourhood A at Kitimat (Fig. 9) provided for only 238 single family houses out of a total of 1,412 dwelling units; 308 families were to be housed in twin houses, 618 in group or row houses and 248 in apartment houses. These figures represented a decision as to what should be built in order to provide accommodation in an efficient manner. The actual development of this neighbourhood has been carried out largely by private builders. Out of a total of 1217 dwelling units 513 (41%) are single family houses, 298 (23%) are twin houses, 147 (12%) are row houses and 259 (25%) are apartment houses. These changes have resulted in a lower overall density in spite of smaller lots for single-family houses. It may be maintained that these figures are the result of a free choice, but actually this is not so for a free choice seldom exists and those coming to the town have to take what is available. Perhaps all we can say is that architects and large scale developers recognize the advantage of multiple dwellings whereas most individuals do not. There are however regional differences and it may be noted that, in Quebec new towns, multiple dwellings are very common.

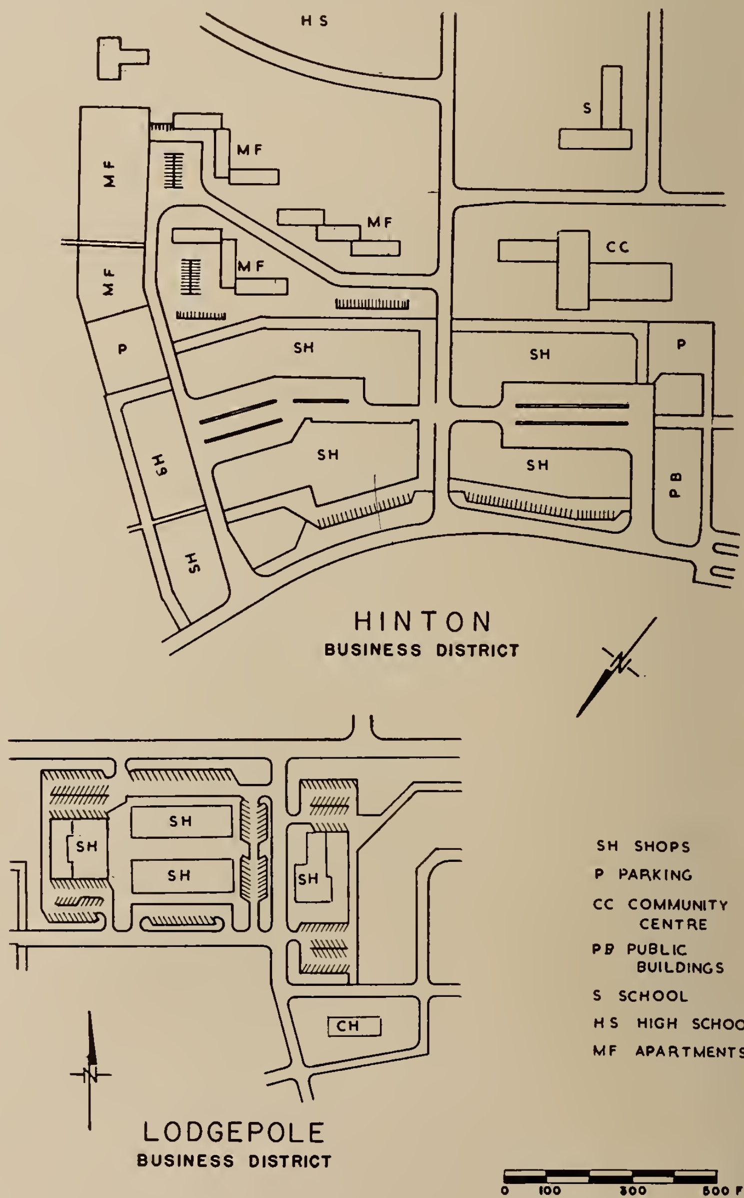
In general, high density housing is located close to the central area, as for example at Hinton (Fig. 10), and this seems a proper arrangement. Outside the central area single-family housing is most common and in most Canadian new towns this means lots approximately 50 ft. x 100 ft. or a little larger. The difficulty is to plan an attractive town composed for the most part of such minimum sized lots. The deadly foe is monotony and this cannot be avoided simply by insisting on a variety of house types. The new towns offer ample opportunity for experiment in this important aspect of civic design. Among the devices that are being used in an attempt to improve the appearance of residential areas, the following may be observed: the use of curved streets to shorten monotonous vistas, varied lines of set back to produce more interesting house groupings, the careful siting of open spaces, schools, and churches. It is doubtful if these measures will be sufficient by themselves to produce attractive residential districts. A greater willingness to experiment with different patterns of residential development is needed. One fact is evident—modern planning of residential areas greatly reduces the number of dangerous intersections. In Manitouwadge and Elliot Lake for example there are virtually no X intersections except for one or two crossings of major roads where traffic circles or other traffic control devices can be used.

It is generally considered that some public open space should be preserved in residential districts, and Central Mortgage and Housing Corporation have stated that properties may be down-graded for appraisal purposes if assurance of adequate open space is lacking.[21] This necessary open space may be provided in the form of internal parks as in a "superblock", e.g. at Kitimat (Fig. 9), or in a more conventional manner with considerable road frontage as at Chibougamau. Neither system is entirely satisfactory and further study of the purposes for which public open space is required and the way in which it is used appear needed.

Site Engineering

It is usual in new towns to construct water supply systems and sanitary sewers, and to grade and gravel the streets before any building takes place. The completeness of these services naturally varies with the size of the town and other factors. The cost of these works may be borne by the town if incorporated, by industry, or by advances from the government. If borne by the town part or all of the cost may be charged back against the lots in the same way as local improvements. Such charges may become more than the lot owner can be reasonably expected to carry. One basic difficulty in a new town is that everything is new and must be paid for at the same time. This problem is common to all new residential areas but is particularly acute in a new town. Practical difficulties have arisen in some new towns in the installation of services. Langlois[14] referring to Chibougamau describes the town as a failure and

Fig. 10 (bottom). Lodgepole — business district. Fig. 11. Hinton — business district.



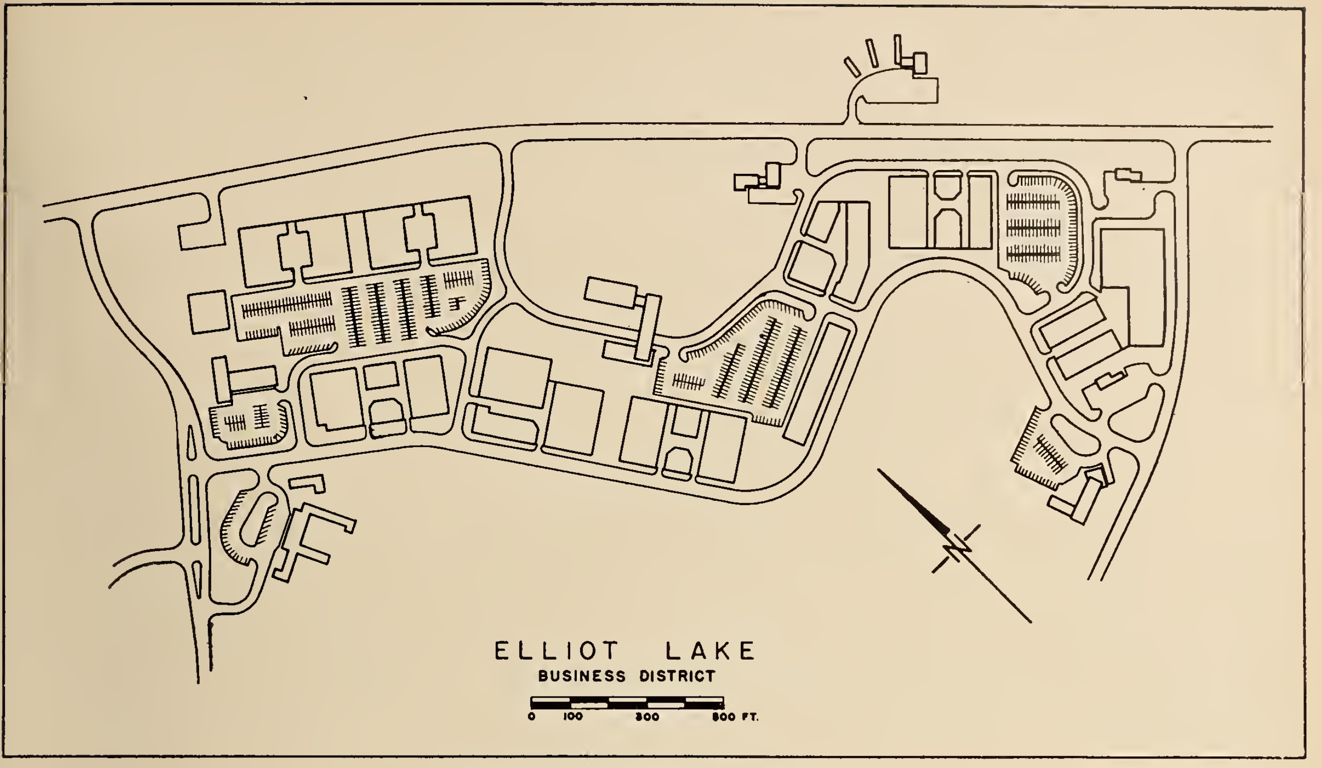


Fig. 12. Elliot Lake — business district.

gives as one reason the errors made by the Provincial government in constructing water mains. In towns having carefully planned road systems it appears to be common to pave the major roads at an early stage in the history of the town. Minor roads are normally paved, if at all, following the construction of the houses. In most parts of Canada it would seem desirable to construct hard surfaced roads as soon as may be practicable rather than to expect the residents to contend with the dust, mud, and pot holes common to unpaved roads.

Sidewalks, except on major thoroughfares, are a luxury and with good planning may not be needed. Few have been built so far.

The most common arrangement for electricity and telephone service is the joint use of poles located at the rear of the lots. In this connection it may be observed that lanes are commonly provided in Alberta but are not popular elsewhere. Underground wiring is being installed in the central areas of some of the larger towns. Off-street parking facilities are common in business districts and are usually paid for by the town as a whole though in some instances part of the cost is charged against business.

Conclusions

It is too early to attempt any evaluation of Canadian new towns and it would be presumptuous to do so in the present brief study. It would seem to be important however that a continuous appraisal be made. Every new town is to some extent an experiment and much can be learned from careful observation of such experiments. In the meantime it seems to the author that the following conclusions may be useful as a basis of discussion.

(1) Governments should accept a general responsibility for the planning of new towns and for the control of development in accordance with general plans.

(2) Governments should be prepared to advance money to finance the construction of new towns.

(3) The location of new towns should be based on adequate regional studies.

(4) Town sites should always be sufficiently large to permit a green belt of substantial width. In the absence of an effective system of regional planning it may be necessary for town sites to be of the order of twenty miles square or more.

(5) The planning of new towns should be done by town planners of high professional standing. In this connection it is desirable that some use be made of consultants.

(6) New towns should be built to good municipal standards. Water supply and sewage disposal systems, storm water drainage systems, hard surfaced roads, sidewalks where needed, street lighting should be constructed if possible in advance of houses.

(7) New towns should be planned and developed as a series of neighbourhoods having populations ranging from 1000 or less up to about 5000.

(8) A start should be made on the central business district early in the history of the town.

(9) It will usually be desirable to encourage some multi-family dwelling units and these should be located close to the central area.

(10) Adequate provision should be made for service industry, the less attractive commercial uses and noxious industry.

Acknowledgments

This paper could not have been written without the willing co-operation of those who are actively concerned with the planning and development of new towns in Canada. In particular, the author wishes to record his appreciation of the advice and assistance received from Mr. D. F. Taylor, Chief Planner, Department of Planning and Development, Province of Ontario, Mr. H. N. Lash, Director of the Long Range Planning Division, City of Toronto Planning Board, formerly Director of Town and Rural Planning, Province

(Continued on page 58)

St. Lawrence Estuary Submarine Power Transmission System

O. W. Titus, M.E.I.C.
President, Canada Wire and Cable Company Limited

Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June, 1957

THIS PAPER describes in broad lines one of the phases in the placing into the service of the people and the economy of the Province of Quebec, the water power resources of the north shore of the Lower St. Lawrence.

The Problem

To bring into focus the basic economic and social aspects, it is appropriate to recapitulate the population versus power resources in the areas affected by this cable project. On the North Shore of the St. Lawrence consider the area draining into the St. Lawrence and lying between the Saguenay River and the Province of Newfoundland. On the South Shore consider that part of Quebec from East of Rivière du Loup through to and including the Gaspé Peninsula. These two areas lie opposite one another, both in many respects the oldest parts of Canada from the white man's viewpoint, and both now entering a turning point in their respective developments.

The North Shore is startlingly rich in power resources but of very meagre agricultural potential, the South Shore very limited in power resources but with very considerable agricultural potential, some moderate sized cities, large towns, and a general population development organized and capable of ready expansion, well served by water, road, and rail transportation, and with large potential in mineral resources. (One large copper mine, that of Gaspé Copper Mines Ltd., already is in large scale production since the installation of the cable. It supports a modern and expanding town in the heart of the Gaspé.)

The one element lacking to let the South Shore achieve its potential was an adequate supply of cheap electrical power.

The North Shore on the other hand is not naturally hospitable to human habitation. Its economic development would appear to trend toward large individual units located on account of some natural resource such as mining or availability of large blocks of cheap power close to deep water transportation. Its development entails the movement of peoples to those sites. The South Shore's future growth one expects should be less individually spectacular. It envisages the enlargement of the potential of present peoples and communities in a more kindly and amenable environment.

In summary, the statistics were approximately as shown in Tables I and II.

The paper describes the economic considerations and the installation of a submarine cable system to link the South Shore of the St. Lawrence estuary to the large hydro-electric power resources of the North Shore via the Manicouagan Peninsula.

The "unshackling" of the South Shore by the provision to it of ample electrical power was the problem. It was attacked with vision, vigour, and courage by the Quebec Hydro-Electric Commission.

Studies were made comparing the estimated long range costs of power for the South Shore area based on:—

(1) Initial installation approximately 75,000 h.p.

(2) Locally developed — Hydro-electric power, 15,000 h.p.; thermal sources, (a) diesel, 6,000 h.p., (b) steam, private industrial plants only.

Studies also were made to compare the economics and operational problems of transmitting from the North Shore via overhead lines via North Shore to vicinity of Quebec City, overhead span across river and overhead along South Shore to vicinity of Rimouski.

These estimates gave overall costs approximately as follows.

Overhead	$7,000,000
Submarine	$6,000,000
Switching and substation	$ 500,000

Consultants of international reputations were employed to advise on the electrical and mechanical problems and feasibilities of such a cable installation and the details of the various elements. It was agreed that the project was feasible.

Accordingly it was decided to proceed with the installation because of:

(1) The economics.

(2) The greatly increased economies as loads increased in the future.

(3) The experience gained which would be of inestimable value in future decisions.

(4) The greatly simplified problems of system stability and voltage control with the relatively short transmission distance to the load centre of 40 miles as against approximately 450 miles via Quebec City and overhead.

(5) The greatly reduced mileage of overhead exposed to icing in a district subject on occasion to extraordinarily bad icing conditions (the overhead part of the South Shore was seriously interrupted for three weeks during the winter of 1955-56 from this cause).

(6) Ease of adding additional circuit or circuits with experience gained in initial installations.

(7) The adaptability of such a cable system to high voltage direct current purposes if that becomes an

accepted and economic method of transmitting large blocks of power.

A reconnaissance of possible crossing sites indicated that the most feasible and economical would be from the Manicouagan Peninsula (between the mouths of Manicouagan and Outarde Rivers, west of Baie Comeau, to Les Boules on the South Shore, approximately 35 miles east of Rimouski).

The choice fell here because:—

(1) It was close to immediately available power (5 miles from the Outarde power plant) and, on the South Shore, Les Boules was well situated as a load centre for the area to be served.

(2) The river bottom conditions were favourable, no submerged ridges, valleys or obstructions.

(3) The small bay at Les Boules offered the minimum risks from rock outcroppings, large boulders, and similar hazards. Also it was possible to bring a cable scow quite close to shore.

(4) The North Shore beach, being an alluvial deposit offered no hazards from rock ridges or boulders. Also it was possible at low spring tides to trench in the cables for 5,000 feet out from high water mark. The distance from high water mark to high water mark was 31½ miles (nautical) and from terminal structure to terminal structure, 32 miles (nautical).

The maximum depth was 1,200 feet at about 2½ miles off shore at each end.

Table I.—General Statistics

	*South Shore	**North Shore
(1) Area (square miles)	15,000	50,000
(2) Population (1951)	248,400	42,700
(3) Water power potential (h.p.)	25,000	6,000,000
(4) Water power developed (1951) (h.p.)	15,000	130,000
(5) Estimated average capital cost per horsepower of undeveloped power (1951) (dollars)	350	175

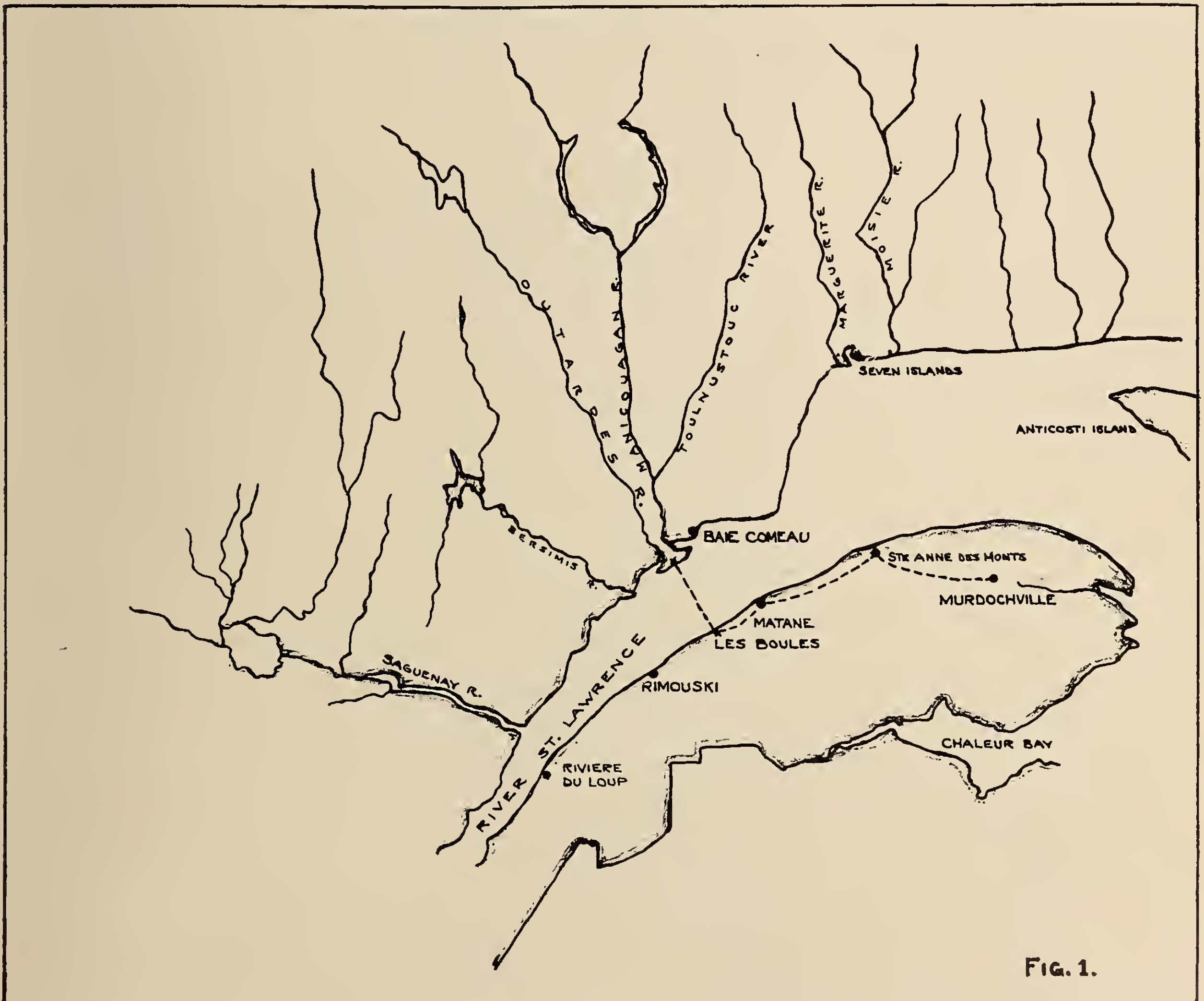
Table II.—Estimated Power Demands of South Shore in Horsepower

	1951	1956	1961	1966
Normal, industrial and commercial	19,000	20,000	25,000	30,000
Domestic	6,000	7,000	10,000	14,000
Major industrial and mining	0	10,000	12,000	18,000
	25,000	37,000	47,000	62,000

*South Shore—Province of Quebec, from east of Rivière du Loup to extremity of Gaspé Peninsula.

**North Shore—Watershed flowing into St. Lawrence eastward from Saguenay River to eastern boundary of Quebec.

Fig. 1. Sketch map of the St. Lawrence estuary area.



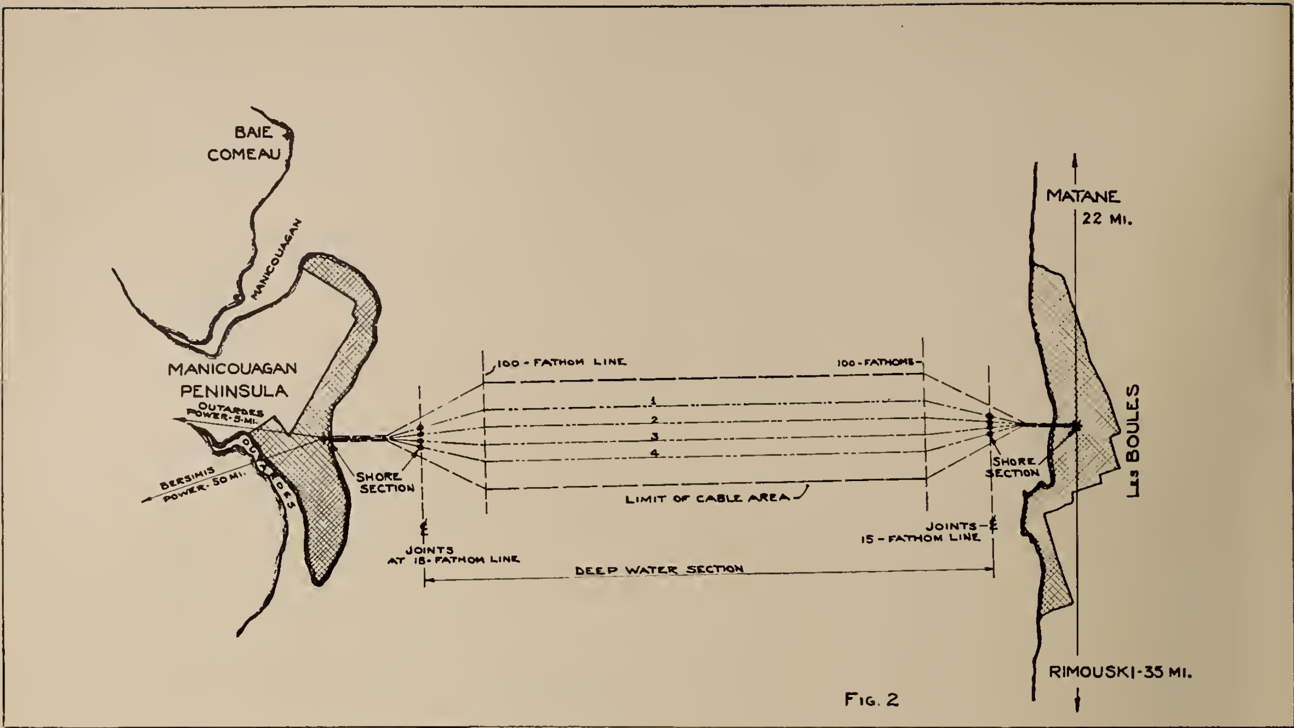


Fig. 2. Map of the site investigated and the cable routes chosen.

The senior captain of the consultants on the laying of the cables viewed the site, and the consultants considered the site suitable.

The site closely investigated and the cable routes chosen are shown in Fig. 2.

Cable Design

The voltage chosen was 69 kv., grounded neutral.

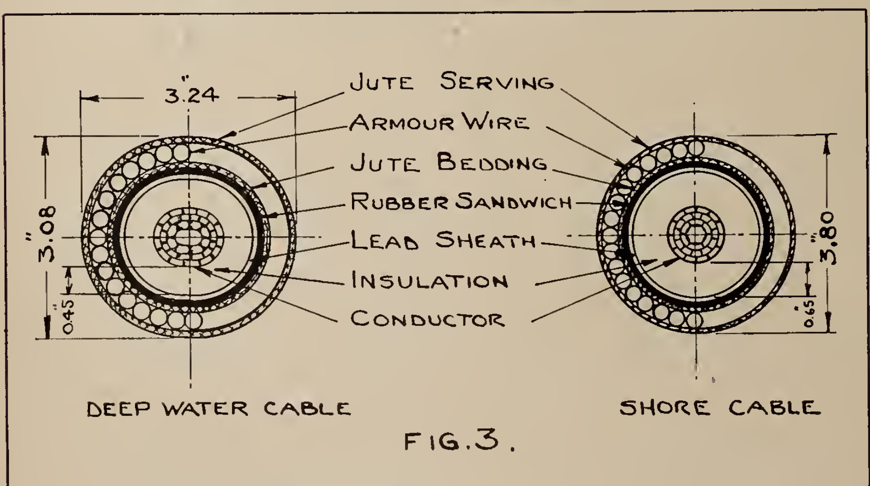
In the design of the cable it was obvious that advantage should be taken of the high external pressures inherent throughout most of the cable route. Insulation thickness was adopted for deepwater section appropriate to a minimum external pressure of 50 p.s.i. (that about 2½ miles off shore) and was chosen as 0.450 inch. An oval cross section was chosen in order to reduce a risk of fatigue due to load cycles working the lead sheathing.

Rather than introduce three cable types, the shore section cables (from about 2½ miles off shore to the terminal structures) were based on "on shore" conditions of ambient temperature, thermal dissipation and absence of external pressure—i.e. a conventional "solid" type 69 kv. directly buried in the earth.

The two types of cable adopted were in detail as in Table III. and are illustrated by Fig. 3.

Aluminum alloy of a type highly resistant to salt water attack was chosen for the armouring rather than steel wire, due to its better electrical and non-magnetic characteristics and its much lesser weight.

Fig. 3. Illustration of the types of cable adopted.



The electrical and magnetic properties of the armour wire are of importance since these are single conductor cables on an alternating current circuit, and induced sheath currents are permitted to flow, the sheaths and armour of each cable being bonded together at approximately three-mile intervals and the sheaths and armour of all cables being bonded together and grounded at each end of the crossing.

The manufacturing problem was one of producing the deepwater cable in four lengths each approximately 150,000 ft. long, and the shore sections in six lengths averaging 15,000 ft. each, and in a position from which they could be loaded into a cable ship.

It was decided that the cable up to and including lead sheathing should be manufactured in the longest lengths reasonably practical from the viewpoints of: (a) handling, and (b) testing at service frequency (i.e. 60 cycles), then shipping to a site on the lower St. Lawrence for splicing together, applying of protective coverings and armour, and coiling down adjacent to a cable ship berth.

The site chosen for the armouring plant was the wharf at Rimouski. A suitable building was erected; a large armouring machine and a wire drawing machine for drawing the aluminum alloy armour wire were installed. External to this building a temporary steel structure was erected, 70 ft. in height and 500 ft. long, with an enclosed gallery on the top into which the cable was fed by haulage gear from the main armouring machine capstan, and along the gallery to the appropriate coiling bay.

This arrangement is illustrated by Fig. 4 (taken when preparing for loading the cable ship).

This method of producing long lengths of submarine cables depended on design of a suitable splice.

Such a splice required to be: (a) of outside dimensions close to that of the lead sheathed cable itself; (b) of mechanical strength close to that of the conductor; (c) of electrical strength close to that of the factory applied insulation; and (d) of flexibility close to that of the cable.

Such a splice was designed and utilized in the cable. This development itself is of outstanding importance. It permits the choice of any type of extra-high voltage cable insulation for use in extra long length submarine power cables. It also permits the cable proper to be subjected, prior to splicing, to all the usual service frequency and over-voltage tests normally demanded by standard specifications.

Fig. 4. Withdrawing deep-water cable from coil No. 1. End of armouring plant in background. Fig. 5 (below) Splices between shore ends and deepwater sections of cable.

Subsequent tests on joints subjected to the numerous bends during flaking down, loading in the cable ship, laying in deep water, lifting back into the cable ship and unloading on to the wharf (a total of at least fifteen to twenty flexures, some under heavy torsional stresses) showed large factors of dielectric strength and practicability of the design.

The splices between the shore ends and the deepwater sections were of a different design as it was not considered necessary that they should be flexible. These splices were made on a barge after picking up the buoyed ends of the previously laid sections. These splices are illustrated by Fig. 5. After completion the splice normally was lowered by slings from the side of the barge as the barge was traversed laterally, although the illustration is an instance of the joint being paid over the end of the barge.

As protection against ice, the shore ends were trenched in to a depth of two feet, out to a depth of six feet, below low water mark.

Additionally on the south shore end when the cables lay over a region of medium sized boulders and reef rock, it was protected until a depth of six feet below low water was reached by coverings of dry concrete in bags.

Also on the north shore where the cable leaves the water, it climbs a clay bluff subject to erosion by wave action. Here the erosion is arrested and the cable protected by a system of stone loaded timber cribbing.

The remainder of the cable on shore was trenched in and buried in the conventional "buried solid" method.

The terminals were of conventional 69 kv. design, were oil-filled, and require no comment.

The principal difficulties encountered in installation were due to several factors.

(1) The tidal currents being variable in direction and force, resulted in serious looping of the first shore length cable which had to be spliced and relocated. Also in one other instance one phase overlaid another and required re-laying.

(2) Heavy weather delaying operations. In one case the side effects of hurricane Carol built up so quickly that the tug and barge became unmanageable as the last 200 feet of a shore length was being laid, resulting in that length fouling other buoy anchor lines and injuring that part of the cable, necessitating an additional joint.

(3) A tendency of the North Shore bottom to scour due to tidal currents caused a cable end mushroom anchor not to hold, resulting in a kink in the cable.

(4) Fog delayed the cable laying operations.

(5) The power content in the induced voltages between the armour and sheath due to the charging currents in single conductor cables of this voltage in a distance of over thirty miles was sufficient to burn a hole in the lead sheath, resulting, after moisture access, in a phase to ground failure. This was overcome by bonding together the sheath and armour every three miles. This reduced the power content at any one point from about 15 kw. to about 28 watts, a value too low to injure the sheath.

(6) Unusually heavy storms in the area twice resulted in the temporary plant on the Rimouski wharf being damaged by heavy seas coming over the wharf and smashing part of the building as well as sinking a dredge in the loading area. Fortunately, neither seriously delayed operations, although inconvenient and expensive.

Final repairs were effected in 1955 and the cable placed in successful operation on November 13th, 1955.

The timing of the project was approximately as follows:—

Table III.—Types of Cable Adopted

	Deepwater Section Oval	*Shore Section Round*
Conductor		
Area (C.M.)	500,000	1,000,000
Stranding (Compack)		
long diam.	0.826 in.	1.060 in.
short diam.	0.666 in.	
Insulation thickness	0.450 in.	0.650 in.
Lead thickness	0.105 in.	0.115 in.
Protective covering over lead	Bitumized rubber sandwich	
Armour	Aluminum alloy 29/0.296 in.	
Protective jute over armour	2 jute servings	
Overall diameter	3.24 in. x 3.080 in.	3.80 in.
Weight/ft.	10 lb.	15 lb.
Total installed length	595,000 ft.	136,000 ft.
" " weight	5,950,000 lb.	2,040,000 lb.

May 1951 — first discussions and studies

Nov. 1951 — tenders received.

Dec. 1951 — letter of intent issued by Quebec Hydro-Electric Commission.

Jan. 1952 — Manufacture of first experimental lengths started at Leaside.

Jun. 1952 — Prime contracts awarded to Canada Wire and Cable Company Limited.

Dec. 12, 1952 — Manufacture of first production length started at Leaside.

Apr. 28, 1953 — Armouring and splicing started at Rimouski.

Jul. 17, 1954 — Cable ship *Monarch* arrived Rimouski.

Aug. 7, 1954 — Laying of deepwater sections completed.

Aug. 20, 1954 — Laying of shore sections completed.

Oct. 3, 1954 — Kedging anchor area splicing completed.

Oct. 9, 1954 — Open circuit discovered.

Oct. 28, 1954 to Dec. 3, 1954; July 15, 1955 to Nov. 13, 1955: Repairs employing cable ship *Lord Kelvin.*

Nov. 13, 1955 — System placed in operation.

Acknowledgments

In charge of the project were D. M Farnham, for Hydro-Quebec, and H. D Short, for Canada Wire and Cable Company Limited who were also prime contractors for cable and accessories and for installation. Consultants were G. B Shanklin, the General Electric Company; Dr. P. A. Bricout; and The Telegraph Construction and Maintenance Co. Ltd.

Planning of Recent New Towns in Canada

(Continued from page 53)

of Alberta, and Mr. Burroughs Pelletier, Director of the Provincial Bureau of Town Planning, Province of Quebec. Information on Kapuskasing was supplied by the Spruce Falls Power and Paper Company, on Kitimat by the Aluminum Company of Canada, on Murdochville by Mr. R. J. McKenna, on Uranium City by Izumi, Arnott and Sugiyama, of Regina, and on Hays, Alberta, by Mr. Mark Mann, P.F.R.A., Vauxhall, Alberta.

References

1. "Single-Enterprise Communities in Canada" Institute of Local Government, Queen's University, Kingston, published by Central Mortgage and Housing Corporation, Ottawa.
2. Bureau of Municipal Affairs "Report re Housing for 1921 including Town Planning of the Town of Kapuskasking," Toronto 1922.
3. Taylor, D. F. Proceedings of the 1956 Conference of Canadian Planning Officials, page 90.
4. "The New Towns Act" Province of Alberta.
5. "The Local Government District Act" Province of Manitoba.
6. Pelletier, B. Proceedings of the 1956 Conference of Canadian Planning Officials, page 82.
7. Mining Villages Act and Mining Towns Act, Province of Quebec.
8. Garden Cities and Town Planning Association, 1919.
9. Rodwin, L. "The British New Towns Policy", page 15.
10. Lash, H. N. "New Towns and Provincial Assistance" paper presented at the Annual Meeting of the Town Planning Institute of Canada, September 1956.
11. Hall, O. "The Social Consequence of Uranium Mining", University of Toronto Quarterly, January 1957.
12. Phillips, A. "Our Wild Atomic City", Macleans Magazine, May 25, 1957.
13. Taylor, D. F. "Planning Principles" paper presented at a Short Course in Town Planning, Queen's University, August 1956.
14. Langlois, C. "Nos Villes Minières: Un Echec". Community Planning Review, March 1957, page 60.
15. Rasmussen, S. E. "Neighbourhood Planning". Town Planning Review, January 1957, pp. 197-258.
16. Egli, E. "Die Neue Stadt in Landschaft und Klima", Zurich, 1951.
17. Lethaby, W. R. "Architecture" page 190.
18. Ontario Planning Supplement Vol. 4 No. 2, 1957 page 9.
19. "Key Points in Planning" Town and Country Planning February 1957 page 71.
20. Robson, W. A. "The New Towns: Their Future Ownership" Town and Country Planning January 1957 page 17.
21. Central Mortgage and Housing Corporation Builders Bulletin No. 79. 1956, page 9.

Brittle Fracture in Steel

As Related to Flash-Welded Line Pipe

M. A. Scheil, *Director of Metallurgical Research*

G. E. Fratcher, *Director of Engineering, Tubular & Process Division*

S. L. Henry, *Assistant Director, Metallurgical Research*

E. H. Uecker, *Director of Quality in Oil Field Products & Ordnance*

A. O. Smith Corporation, Milwaukee, Wisconsin

Contributed by the ASME Petroleum Division for presentation at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June, 1957

A GAS PIPELINE in operation is in essence a pressure vessel when one considers that within a hundred miles of line (between compressor stations) there are over 13,000 pieces of 40-ft. length pipe involving over 31,000 tons of steel for a 30-in. diam. line. It is therefore interesting to consider the literature on pressure vessels with this in mind.

An excellent article was prepared by Prof. L. J. McGeady[1] of Lafayette College for the Pressure Vessel Research Committee covering the effects of temperature on pressure-vessel steels in the range from +32° to —50°F, with particular emphasis on transition-temperature behavior. This article contains a bibliography of important literature references.

The data of MacKenzie[2] from McGeady's article is plotted in Fig. 1 to show the range in transition temperature obtained from 68 heats of semi-killed and rimming steel rolled to different plate thickness. MacKenzie's data covered plates 0.4 to 1.5 in. thick. In Fig. 1 we have added the results from the Armour Research Foundation (ARF)[3] report to the American Gas Association (AGA) on transverse and longitudinal 2/3 standard size Charpy vee-notch-impact tests taken from 198 heats of API Grade X52 steel expanded line pipe produced by six pipe manufacturers in sizes 20 to 34 in. diam. and from 0.281 to 0.375 in. wall thickness. ARF used 10 ft.-lb. as the transition temperature and obtained a spread of —30° to +74°F with a mean of +34.9°F for transverse specimens from 198 different heats of steel. The longitudinal specimens from 53 heats of steel had a spread in transition temperature of —50° to +45°F with a mean of —4.5°F. It is observed that the extension of the plotted line for average transition temperature at 10 ft.-lb. obtained from MacKenzie's data runs through the point for the mean transition temperature for X52 grade steels of 0.281 to 0.375 in.

Fig. 1 shows that an increase in rolled-plate thickness from 0.3 to 1.5 in. results in an increase of the Charpy vee-notch transition temperatures of 5.5°F per 0.1 in. increase in plate thickness. This figure shows agreement with Vanderbeck's data[4] on rolled plate of ½ to 1½ in. thickness reported as an increase in transition temperature of about 20° to 40°F per ½ in. increase in thickness in several varieties of steels.

ARF in its report to AGA comments as follows: "Under most service conditions overstressing causes steel to yield in a perfectly normal manner. If the stress continues to increase, the steel eventually fails by separation along active slip planes after a large amount of shear deformation has been introduced. Because of the large amount of deformation preceding fracture the energy absorbed is high. Under other conditions, overstressing the same piece of steel results in sudden fracture of the piece by cleavage, with little or no shear deformation preceding failure. The energy absorbed is much lower. The conditions favouring cleavage failure are known in a general way. Low temperatures, high concentrations of triaxial stress, and rapid application of stress (shock loading) all tend to increase the probability of cleavage failure of a given specimen of steel. If a group of different specimens of nearly identical strength properties is investigated, the ease with which cleavage failure can be induced generally will vary from specimen to specimen. This variability has been found in many investigations to be related in a complicated way to chemical composition and microstructure. It is also known that differences in the manufacturing process can influence the variability[5].

No discussion on brittle fracture of steel would be complete without reference to the work at the U.S. Naval Research Laboratory by W. S. Pellini, P. P. Puzak, and others.

Mr. Pellini presents a convincing story and has the only explanation which, at this time, can be used to fit together the tests which have been made to determine the tendency toward brittle behavior of ferritic steel. His viewpoint has considerable support and until a better one is found or until facts can be presented to

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This is Part II of three papers dealing with flash-welded line pipe. It discusses the concepts of brittle fracture for 0.20%-0.30% carbon medium manganese steel. Part I, published in The Engineering Journal, *Jan. 1958, pp. 60-71, described the manufacture of flash welded line pipe, the research facilities required, and metallurgical properties. Part III follows this paper* *on page 64 of this issue.*

prove him wrong, his thinking will influence design for a large percentage of fabricated structures over ½ in. in thickness of ferritic materials.

We will examine some of the concepts that Pellini has presented and see how they fit large-diameter line pipe for low-temperature services.

General Considerations of Brittle Fracture

(1) Brittle fracture of structures operating at 0°F and higher is a serious problem at this time only in thicknesses of ¾ in. or more. In tests made on 68 heats of steel the British have shown that at 0.4-in. thickness the 10-ft.-lb. transition is —24° to +45°F. For thinner sections of hot-rolled steel the transition from ductile to brittle behavior is increasingly lowered. ARF reports —50° to +45°F with a mean of —4.5°F for 0.281 to 0.375 in. expanded line pipe.

(2) Pellini and his group are not advocating a demand for notch ductility unless service failures demand it or unless the operating risk is so great that no possibility of failure can be tolerated. Critical locations in atomic-energy plants and certain military applications are an example of the latter. It is recognized that specification of notch ductility in carbon steel is expensive and would cripple our steelmaking capacity* greatly if used indiscriminately[6].

Ductile failure in structures is no problem for it seldom occurs. If it does occur it is due to poor engineering design or overloads. Brittle fracture, since it occurs at stresses below design stress, is dangerous and, if economical methods can be found which will avoid it, most assuredly those methods will find wide acceptance.

The best known and most used test method of determining brittle behavior is the Charpy vee-notch-impact test. The actual energy absorbed is a variable for comparing different steel types. The type of fracture is the criterion. For example, a malleable iron with 8 or 10 ft.-lb. energy in the standard Charpy vee-notch test may break in shear at this energy level. On the other hand, a heat-treated alloy steel may be considered unsatisfactory at its 35 to 45-ft.-lb. temperature in the same test if the fracture is by cleavage.

The concept of ductility transition and fracture transition was described by the Lehigh group in 1948. The stress necessary to propagate brittle fracture, about 5000 psi, in mild steel was separately arrived at by Robertson in England and Feely of the Esso Research and Engineering Company in the U.S.A. The Naval Research Laboratory's contribution has been a formulation of these various studies and correlation of the Charpy vee with all the other fracture-test specimens.

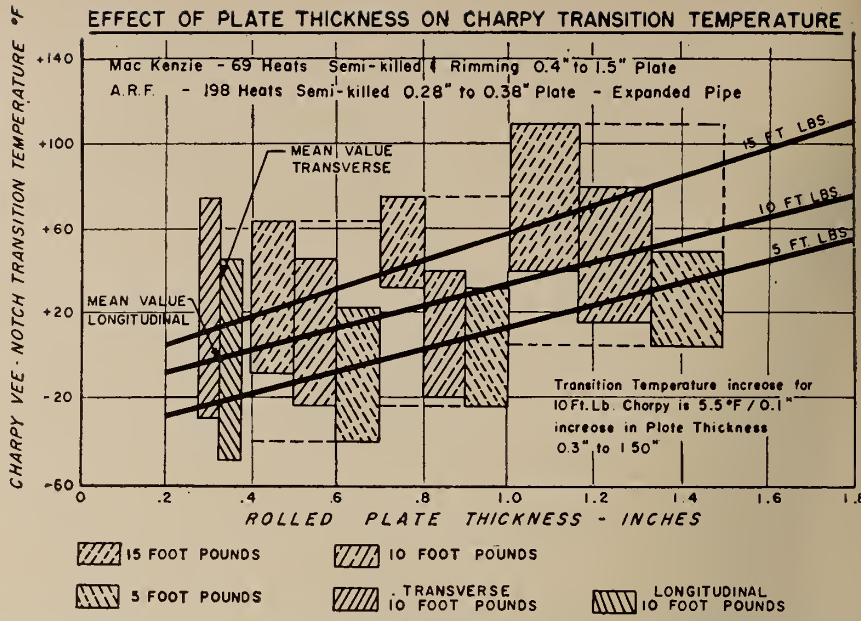

Fig. 1. Relation of Charpy transition temperature with plate thickness of mild steel and semi-killed steel.

Definition of Terms Used to Describe Transition Temperature

The nil ductility transition (NDT) is that temperature below which minute plastic deformation cannot be developed in the presence of a sharp crack defect. Under even nominal elastic loads in the presence of a sharp crack, brittle fractures can initiate at or below the NDT temperature. Fracture transition is defined as follows: FTE (fracture transition for elastic loading) is that temperature below which fracture may propagate easily through elastic-load regions (virgin material) but above which propagation is possible only through cold-worked (deformed) material; e.g., below FTE, fracture will not initiate under nominal elastic loads but will require the forcing (plastic deformation) to get it started. However, once started below the FTE temperature, propagation is possible even though the remainder of the structure is under nominal elastic loads. Above the FTE temperature forcing is again required to initiate brittle fracture but propagation is confined solely to plastically deformed regions. FTP (fracture transition for plastic loading) is defined as that temperature above which only shear tearing is possible irrespective of conditions of loading.

The Robertson and Feely tests do not indicate that 5000 psi is necessary to initiate brittle fracture in the presence of a sharp crack, but instead, that nominally elastic loads as low as 5000 psi are sufficient to maintain fracture propagation at temperatures below the FTE, which is equivalent to Robertson's crack-arrest temperature (CAT) and the Feely Esso brittle temperature (EBT).

Metallurgical Concepts

(1) The "brittle-fracture" concept explained by Pellini applies only to ferritic steel. For example, copper, aluminum, and austentic steel do not fail in cleavage.

(2) The ductility and fracture transition may be related to the Charpy vee-notch performance. The actual foot-pound energy measured in the Charpy test is meaningless except for one specific composition and heat-treatment. The shape of the transition curve must be established.

(3) Brittle fracture has no directionality sense. The energy absorbed in the Charpy vee-notch test will vary according to specimen orientation with respect to rolling direction, but the shape and transition features of the curve will not show directionality effects.

(4) There is no difference, in so far as transition temperature is concerned, between cast and wrought alloys if composition is the same and a crack exists. If no crack exists the

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*15 million tons/year is the capacity of USA for killed steel.

ductility transition of the wrought plate may be lower than the cast plate because fewer material (metallurgical) cracks exist in the wrought material.

(5) Transition temperature is structure sensitive and it is believed that the thinner material is more resistant to brittle fracture because of the greater working which it receives. It is Pellini's opinion that the nickel steels are useful in low-temperature work mainly because of their extremely fine grain size. Research[7] indicates that smaller ASTM grain size lowers the transition temperature. Doubling the number of ferrite grains (corresponding to an increase of one grain-size number on the ASTM scale) by heat-treatment causes approximately 25°F decrease in Charpy vee-notch transition temperature.

(6) Phosphorus and carbon raise the ductility transition temperature. Silicon raises it when greater than about 2 per cent. Manganese acts to lower the ductility transition.

(7) Generally, welds have a lower ductility transition than comparable plate stock.

(8) Cleavage strength is not sensitive to temperature. Shear strength is sensitive to temperature, rising rapidly as the temperature of ferritic steel is lowered. One can force cleavage failure by lowering the temperature or introducing a stress concentration or both. Lowering the temperature acts to cause a cleavage fracture by increasing the shear strength above the cleavage strength with the result that failure is by cleavage. A crack acts to cause brittle behavior because a small area under high stress is surrounded by a large area under relatively low stress. This acts to discourage slip or shear, thereby raising the shear strength. The point is made that the maximum stress at a sharp crack position under uniaxial loading is three times the nominal uniaxial yield stress. Thus it is inferred that the maximum effective stress concentration factor is 3.*

Table I—Average of Armour Research Foundation Tests

Charpy Transition Temperature, deg. F. Based on 10 ft.-lb., 2/3 standard Charpy vee-notch bar		Fracture Transition Temperature, deg. F. Based on 50% shear fracture on Charpy specimen	
Longitudinal deg. F.	Transverse, deg. F.	Longitudinal, deg. F.	Transverse, deg. F.
−2	+32	+50	+58

(9) The NRL uses the explosion-crack starter test to determine the fracture-transition temperature. The drop-weight test[8] also establishes the NDT temperature. For one given steel, the NDT temperature found by either the explosion-bulge test or the drop-weight test is essentially equal. Since the speed of the two tests differs greatly but the same NDT temperature is established in both tests, it is concluded that in the presence of the cleavage cracks developed in the crack-starter weld, the rate of application of load has no significant effect on the NDT temperature. In both the drop-weight and explosion-crack-starter tests, the same hard-facing weld deposit is used to initiate the sharp crack which develops at the moment the surface fibers of the test specimens reach incipient yield-stress conditions.

Mechanical and Design Concepts

The design concept offered by Pellini and the Naval Research Laboratory group is a method of design to guard against brittle fracture. It is a consideration in only certain specific cases, as for instance when:

(a) The operating risk is so great that no possibility of failure can be tolerated.

(b) Thickness is over ½ or ¾ in.

(c) Material is ferritic steel or iron.

(d) Temperature of service is below 180°F (depending on the material).

(e) Sharp notches must be present.

Figure 2 shows the nil-ductility range for a number of steels and iron. There are four possibilities which a designer should consider before using the values in Fig. 2.

(a) If the consequences of a brittle failure are not important obviously it is not necessary to use it as a design criterion.

(b) Below the nil-ductility-temperature range in the presence of a sharp notch or crack a brittle fracture can initiate and propagate at a nominal stress of 5000 psi.†

(c) From the nil-ductility range to a temperature of approximately 40 or 50 deg. F above this range a sharp crack cannot initiate brittle fracture under nominal elastic loads, but if forced (plastic deformation) it can propagate.

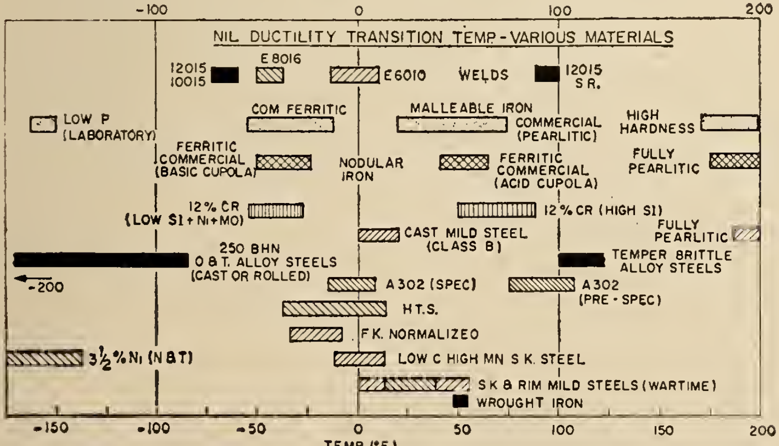
(d) At 100 deg. F above the nil-ductility transition, fracture is entirely shear.

Discussion of Pellini's Concepts

Of interest to pipeline engineers should be statement (3) of Metallurgical Concepts. We took 53 heats of expanded X52 grades steel line pipe and compared the Charpy transition temperature for longitudinal and transverse direction to rolling. An average of the ARF tests revealed the results in Table I.

The maximum energy in foot-lb. for longitudinal direction was 44 ft.-lb. as compared to 25ft.-lb. for the transverse direction. Better agreement in the transition temperature for longitudinal and transverse direction is obtained by the criterion of 50 per cent shear on the fracture surface of the Charpy bars. Fracture transition temperature (50 per cent cleavage) is very insensitive to specimen type or geometry, wheras ductility or energy transition temperatures are quite sensitive to these variables. The average

Fig. 2. Nil ductility range for steels and irons (from Pellini).



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*From the work of Orowan, Felbeck, and others at Massachusetts Innstitute of Technology, Cambridge, Mass.

†From Robertson and also Esso Group.

values indicated in Table I should be compared with mean transition temperatures of minus 4.5°F (longitudinal) and +34.9°F (transverse); the former from 53 heats, the latter from 198 heats.

information can be translated into formulas and tables of value to the designer.

Pellini[8] and Puzak have developed a test at NRL, now widely used for guidance by the Bureau of Ships, called the drop-weight test. The test operates on the principle that a steel which is unable to develop a small amount of deformation below a certain temperature (NDT—nil ductility transition temperature) in the presence of a sharp crack, is potentially capable of experiencing catastrophic failure in service below that subject temperature.

Table II—Charpy Tests of AWS E7010 Weld Metal *

Temperature of test	75°F	0°F	−50°F	−75°F	−100°F
Vee notch	40.0	23.5	12.0	15.6	4.2
	42.1	25.6	17.9	13.5	12.9
	42.2	30.2	15.2	16.7	14.1
Keyhole notch	21.9	19.0	17.9	17.2	15.4
	20.7	19.4	21.3	3.0	16.5
	22.5	20.3	16.1	18.2	19.2
Ratio keyhole/vee	0.52	0.74	1.23	0.84	1.63

* Electrode developed especially for pipeline welding

Concept 4 poses an interesting problem for the chief inspector on pipelines for the field girth seam and longitudinal seams of arc-welded pipe. Barkow and Strong [8, 9, 10] have reported good articles on the control and inspection of line-pipe welding.

The Charpy transition temperature for AWS E7010 electrodes developed especially for pipe-line welding used on girth seams of 30-in. x 0.375-in.-wall line pipe X52 grade steel gave the vee-notch and keyhole energy values in Table II; e.g. 5/32 in. diameter for the stringer or root bead and hot pass, and 3/16 in. diam. for the filler layers. Welding technique was standard linepipe welding procedure, interpass temperature 190°F maximum. Charpy tests, 2/3 standard size 0.263 in. x 0.394 in.

The ratio of area below the notch keyhole/vee=0.625. (Table II)

Concept 5 is certainly of interest to mechanical engineers as it is true that while a great deal of study has been devoted to cleavage failure of steel, it is unfortunately true that little of this

Table III presents data reported by NRL* of more recent investigations of casualty material from a number of sources.

From a consideration of the mechanical and design concepts listed previously, four possibilities are presented to the pipeline design engineer to avoid possible brittle fracture in service.

It is obvious that the design engineer cannot limit line-pipe stresses to 5000 psi, so according to Pellini, brittle fracture will initiate and propagate from a sharp notch below the NDT transition (approximately 10 ft.-lb. Charpy vee notch for rimming and semi-killed steels).

Mr. Pellini states that a crack cannot initiate brittle fracture if the service temperature is about 50 deg. F above NDT but if forced will propagate. Epstein[11] states that generally the 15 ft.-lb. vee-notch Charpy transition temperature occurs at about 35 deg. F higher temperature than the 15-ft.-lb. keyhole Charpy transition temperature. This is the basis for the somewhat widely accepted Charpy keyhole value of 15 ft.-lb. Similarly, Charpy vee-notch value of about 5 ft.-lb. to 10 ft.-lb. correspond to about 15 ft.-lb. keyhole value[12].

Of most importance, we believe, is our generalization for semi-killed steel: that to obtain 100 per cent shear fracture, the service temperature must be at least 100 deg. F over the toughness temperature required to prevent nonductile crack propagation.

From a study of many temperature-transition-Charpy vee-notch curves, there is a definite correlation in the 100 per cent shear-fracture transition temperature and the so-called upper plateau of the impact transition curve. The upper plateau of the impact transition curve correlates in temperature to Pellini's value of NDT plus 100 deg. F for shear.

In the ARF report on expanded X52-grade steel line pipe, adding 100 deg. F to the mean value of +34.9 for Charpy transition temperature would give a temperature which always produced 100 per cent shear fracture and was on the upper plateau of the impact-transition curve. There is no doubt then that if the pipeline engineer desires to have a ductile shear-type failure in present-day expanded X52 grade steel line pipe this

*Report of NRL Progress, July, 1956, Naval Research Laboratory, Washington, D.C.

Table III—Drop-Weight-Test Correlations to Service Fractures

Case No.	*Service*	*Material*	*Failure History*	*Service Failure Temp.*	*Drop Weight Nil Ductility Transition (NDT)*	*Charpy V at Failure Temp.*	*Charpy V at NDT*
1	Ship	Carbon Steel	(December 1947). Ship broke in half while tied at dock.	35°F	50°F	7 ft.-lb	10 ft.-lb.
2 to 34	Ship	Carbon Steel	(1942 to 1951). 18 Steels involved in ship fractures: balance are equivalent types obtained from various shipyard stocks.	Winter Temperatures	0°F to 60°F	3 ft.-lb. to 11 ft.-lb. range Av. 7.4 ft.-lb.	3 ft.-lb. to 10 ft.-lb. range Av. 6 ft.-lb.
35	Anchor Windlass	1045 Steel Forging	(May 1955). Coupling fractured in half while raising port anchor.	70°F	100°F	5 ft.-lb.	7 ft.-lb.
36	Pressure Vessel	Carbon Steel	(April 1955). Complete longitudinal fracture during hydrostatic test.	60°F to 70°F	80°F	7 ft.-lb.	9 ft.-lb.
37	Pressure Vessel	A302(Mn-Mo)	(January 1954). Complete shell and both heads fractured during hydrostatic test.	55°F to 60°F	70°F	7 ft.-lb. to 9 ft.-lb.	11 ft.-lb.
38	Pressure Vessel	A302(Mn-Mo)	(October 1954). 9-ft. fracture in shell due to residual welding stresses during fabrication.	55°F to 60°F	100°F	20 ft.-lb.	33 ft.-lb.
39	Pressure Vessel	2½% Ni, 1/2% Mo, 0.07%V	(January 1956). Vessel fractured in half during service.	60°F to 70°F	130°F	17 ft.-lb.	31 ft.-lb.
40	Pressure Vessel	A204(Mn-Mo)	(February 1956). 30-ft. fracture in shell and one head during hydrostatic test.	40°F to 50°F	80°F	4 ft.-lb.	5 ft.-lb.
41	Generator Retaining Ring	3½% Ni, 1% Cr (Material temper-embrittled).	(February 1955). Fractured into pieces as the result of small cracks developed by electrical arc short at keyway position during service.	115°F	180°F	5 ft.-lb.	8 ft.-lb.

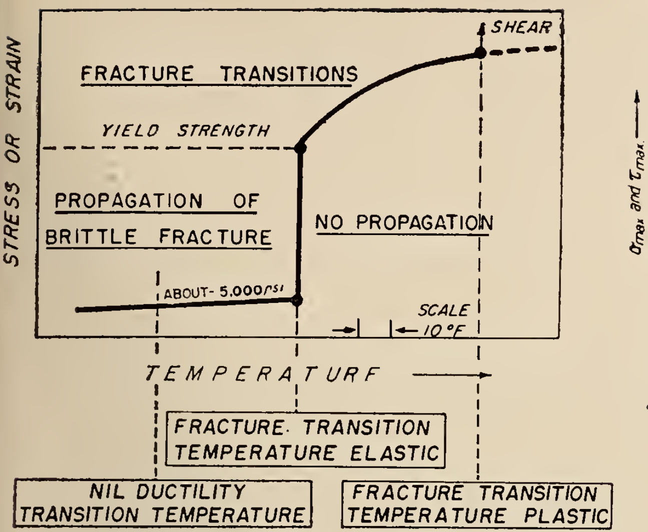
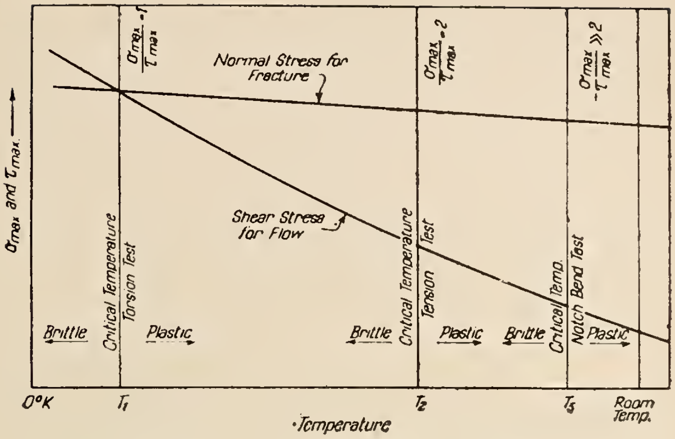


Fig. 3. Summary of metallurgical concepts for brittle fracture in steel (from Pellini).



Temperature dependence of critical flow stress and critical fracture stress. The brittle temperature in several tests. The brittle temperature comes where: $\frac{\text{shear stress for flow}}{\text{normal stress for fracture}} = \frac{\tau \text{ max. in test}}{\sigma \text{ max. in test}}$

Fig. 4. Effect of temperature on fracture of steel in tension, torsion, and notch bending (from "Strength of Metals under Combined Stresses", by Dr. M. Gensamer).

can be obtained only with the steel heated to 140 to 180°F.

Summary

To summarize, the metallurgical concepts presently held for brittle fracture in steel can be graphically presented in Fig. 3 showing a typical curve for a mild steel with the stress and temperature necessary to propagate a fracture.

The point of the fracture transition shifts up or down in temperature depending on deoxidation treatment, steelmaking practice and on rolled plate thickness.

The curve is obtained as follows: A plate 6 in. wide is gripped in a testing machine under a series of temperature and stresses. A small sharp crack is forced to initiate at one side of the plate. At any temperature below the fracture transition the crack will proceed across the plate with no measurable deformation at a stress of about 5000 psi. Above the fracture transition temperature the crack will not propagate until the load is over the yield strength of the steel. This type of curve was developed by Robertson in England and by the Esso Standard Oil Development[13] group in the U.S.A.

The nil-ductility transition temperature shown is obtained from either Charpy tests, drop-weight test or explosion-bulge test.

Prof. Maxwell Gensamer, Columbia University has prepared an excellent treatise for engineers in his series of educational lectures entitled "Strength of Metals Under Combined Stresses."*

*Copyright 1941, American Society for Metals, Cleveland, Ohio.

As an illustration of the effect of temperature in making a metal become brittle in tension, compression and torsion, Fig 4 shows schematically how the relative temperature dependence of resistance to flow and to fracture predicts such behavior. Whether or not the metal will be brittle or ductile depends on whether it first reaches the maximum normal stress required for fracture or the maximum shear stress required for flow. For example, at a sufficiently high temperature, the maximum shear stress required for flow is so low that under almost any condition of loading it will be reached before the maximum normal stress reaches its critical value, so in almost any test a metal will be ductile at high temperatures.

As temperature is lowered, the shear stress required for flow increases, while the normal stress for fracture changes very little, so that as the temperature is lowered the danger of brittle failure becomes greater.

Of the three tests shown in Fig 4, the notch-bend test provides the greatest ratio of maximum normal to maximum shear stress, and it is generally the case that as the temperature is lowered metals become brittle in the notch-bend test before they lose their ductility in tension or twisting. The danger of brittle behavior is expected to be greater in tension than in twisting, and it is true that at low temperatures metals may be brittle in tension but retain their ductility in torsion.

There is no mystery in obtaining 100 per cent shear-type fracture in a steel structure with the knowledge we now have of the transition temperature on steel. If the pipeline engineer wants to operate steel at 0°F and desires to have a notch-ductile steel at that temperature which will always fail in shear, he is going to have to pay the price for specially alloyed, heat-treated steel with a Charpy transition temperature of at least —100°F and a value of something between 20 to 25 ft.-lb. Charpy vee-notch energy depending on whether the steel is hot-rolled or heat-treated.

References

1. "Transition Temperature Behavior of Pressure Vessel Steels," by L. G. McGeady, **The Welding Journal**, vol. 20, Research Supplement, 1955, pp. 1s-11s.

2. "Notch Ductility of Mild Steel Ship Quality Plates," by I. M. MacKenzie, The West of Scotland Iron and Steel Institute, vol. 15, May, 1953.

3. "Investigation of Notch Toughness of Gas Line Pipe Steels," ARF Project No. B566, August 2, 1956.

4. "Evaluating Carbon Plate Steels by the Keyhole Charpy Impact Test," by R. W. Vanderbeck, **The Welding Journal**, 30 (1) Research Supplement, 1951.

5. "Physical Characteristics of Steel for Tubular Products," by A. B. Wilder, ASTM, vol. 47, June 1947, pp. 596-614.

6. "Low Temperature Brittleness," by C. S. Barrett, **Metal Progress**, December, 1956.

7. "An Investigation of the Influence of Deoxidation and Chemical Composition on Notched Bar Properties of Semi-Killed Ship Steel," by R. H. Frazier, F. W. Boulger, and C. H. Lorig, Ship Structure Committee Report, Serial No. SSC-53, November 28, 1952.

8. "Notch Ductility of Weld Metal," by W. S. Pellini, **The Welding Journal**, vol. 35, (5) Research Supplement, 1956, pp. 217s-233s.

9. "Welding Specification and the Contractor," by R. G. Strong and A. G. Barkow, **The Petroleum Engineer**, vol. 25, March, 1953, pp. D-35 - D-37.

10. "How to Interpret Radiographs of Pipe-Line Welding Defects," by A. G. Barkow, **Oil and Gas Journal**, vol. 50, October 4, 1951, pp. 177-180, 183, 186, 268-296, 271.

11. "Notch Resistance of Carbon Steel Ship Plate," by S. Epstein, paper presented at Philadelphia Regional Meeting of AISI, 1951.

12. "Initiation and Propagation of Brittle Fracture of Structural Steels," by P. P. Puzak, E. W. Eschbacher, and W. S. Pellini, **The Welding Journal**, vol. 31 (12), Research Supplement, 1952, pp. 561s-582s.

13. "Report on Brittle Fracture Studies," by Feely, Hrtko, Kleppe and Northrup, **The Welding Journal**, vol. 33 (2), Research Supplement, 1954, pp. 99s-111s.

Flash-Welded Line Pipe — Part III

Low-Temperature Burst Tests of Flash-Welded Line Pipe

M. A. Scheil, *Director of Metallurgical Research*

G. E. Fratcher, *Director of Engineering, Tubular & Process Division*

S. L. Henry, *Assistant Director, Metallurgical Research*

E. H. Uecker, *Director of Quality in Oil Field Products & Ordnance*

A. O. Smith Corporation, Milwaukee, Wisconsin

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WITH THE THOUGHT expressed by company engineers that burst tests of X52 steel at subzero temperatures would contribute to the knowledge of the performance under low-temperature conditions, line-pipe tests down to —50°F were conducted. The results were compared with more than 2000 burst tests at atmospheric temperatures of all sizes and grades that had been manufactured by the company since 1927.

In order better to compare the performance of pipe under hydrostatic burst conditions at —50°F with pipe at a temperature where 100 per cent ductile shear fracture was assured from transition-temperature data a single test was performed at +180°F.

Test Procedure

The following procedure was used in cooling the test pipe to the desired temperature. After the entire system was filled with brine the brine tank of 750 gal. capacity was cooled by the addition of dry ice, and the cold brine was circulated by means of a pump through two accumulator pipes connected in series having a total capacity of 120 gal. and then to the test pipe which had a capacity of approximately 550 gal. and back to the brine cooling tank. A schematic diagram is shown in Fig. 1. After the test pipe had attained the uniform desired temperature, as determined by thermocouples cemented to its outside diameter, circulation of the cold brine was stopped. The burst test was accomplished at the desired temperature by pumping brine at atmospheric temperature from the measuring column (water column) with the high-pressure pump into the closed system. This forced only refrigerated brine from the accumulator pipe into the test pipe. Approximately 6 hr. were required to cool the test pipe uniformly to minus 50°F.

This is Part III of three papers dealing with flash-welded line pipe. It discusses several burst tests conducted down to —50°F. and compares them with similar data for ambient temperature. Ductility developed in burst tests at the different temperatures was comparable. Part I of the series The Engineering Journal, *Jan. 1958, p. 60) dealt with manufacture of flash-welded line pipe, research, and metallurgy. Part II is on p.59, this issue.*

The calcium-chloride brine was made up to a specific gravity of 1.260 at plus 60° F which resulted in a freezing point of approximately minus 60°F. Flake $CaCl_2$ amounting to 5.1 lb. per gal. of water was used to arrive at the desired specific gravity and the solution was inhibited with 20 lb. of sodium dichromate per 1000 gal. of solution.

The temperature rise of the test pipe during a burst test which was of approximately 30 min. duration was determined as 5°F per hr. after circulation of the refrigerated brine was stopped. This low rate was attained because of the frost insulation and the confinement of the pipe in the test pit.

The burst test at plus 180°F was accomplished by using the foregoing system with water. The water was heated in the mixing tank by direct admission of steam and the resulting hot water was circulated through the accumulator pipes and the test pipe.

Chemistry

Chemical analyses taken from each pipe are given in Table I. The carbon equivalent, C+Mn/4 ranged from 0.495 to 0.585 and had no apparent effect on the performance of the individual pipe in the burst tests or the notch bar tests. Little, if any, effect can be noted of the carbon equivalent on the other mechanical properties.

Transverse Charpy vee-notch tests were made on each of the pipes tested in this program. The results of these conducted over a range of temperatures from minus 100° to +212°F are presented as Table II and are plotted as transition curves in Fig 2. It will be noted that the transition temperature is consistent between 32° and 60°F.

The results of strip tensile tests, both longitudinal and transverse are presented in Table III. The results of these tests meet the requirements of X52 pipe.

The results of the burst tests are presented in Table III and the water-column curves of the burst tests are attached as Figs. 3 and through 9.

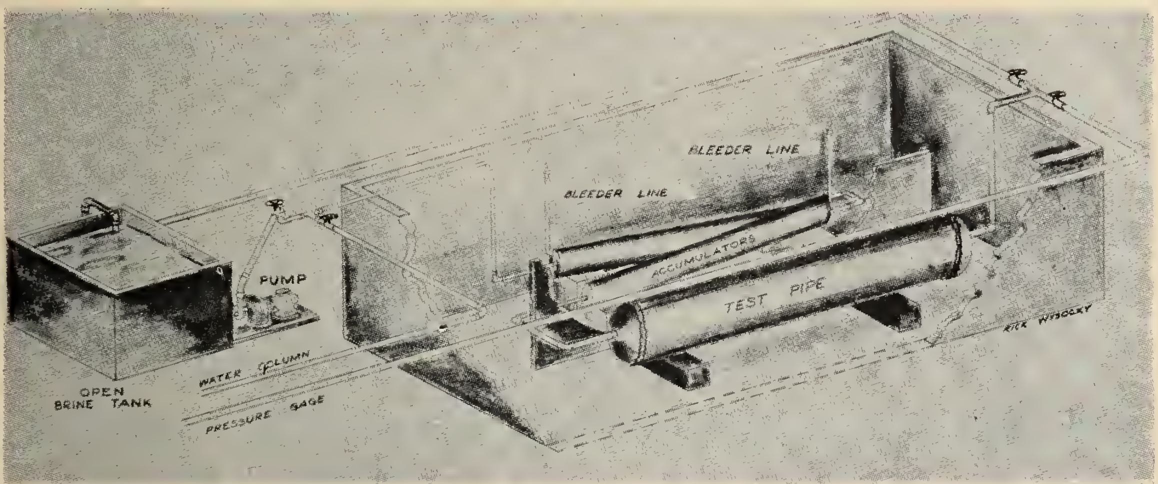


Fig. 1. Linear perspective of test set-up. (Capacities: brine tank, 750 gal.; accumulator, 60 gal. each; test pipe, 550 gal.)

Discussion of Results

Test A-1

Test A-1 was made on a 15-ft. length of X52 line pipe 26 in. diam. by 0.500 in. wall thickness with welded-on flat heads. The pipe was removed from storage at the Milwaukee Works and the flat heads were obtained from stock. The pipe was cooled to minus 3°F and the burst test was completed with a final temperature of 0°F. In the preliminary discussions of pipelines to be located in the colder regions of Canada it was estimated that the majority of the line could be at a temperature 0°F. The yield strength of the pipe was obtained from the pressure at a volumetric set of 0.2 per cent as measured by the water column and the ultimate strength was calculated from the burst pressure. The Barlow formula was used in calculating these values. The yield and ultimate strength thus determined compared favorably with the transverse-strip tensile tests. The circumferential stretch as measured after burst was an average of 3.91 in. In a survey of 1200 burst tests made at normal atmospheric temperatures the average stretch in ¼ to ½-in. wall pipe was 2⅝ in. after burst.

Table I. Chemical and Spectrographic Analyses

Pipe No.	*C*	*Mn*	*P*	*S*	*Si*	*C + Mn/4*
A.	0.29	1.03	0.021	0.020	0.02	0.55
C.	0.32	1.06	0.017	0.030	0.06	0.585
E.	0.27	0.90	0.012	0.023	0.04	0.495
F.	0.28	0.88	0.018	0.034	0.04	0.50

Spectrographic Analysis

	Mn	*Si*	*Cr*	*Ni*	*Al*	*Mo*	*Cu*	*Sn*	*V*	*Ti*
A.	1.05	0.04	0.04	0.01	0.001	0.01	0.015	0.01	Nil	Nil
C.	0.92	0.04	0.05	0.09	0.01	0.01	0.28	0.01	Nil	Nil

The length of burst was approximately 6 ft. with origin of fracture ¾ in. from the longitudinal weld seam. The pattern of fracture is as shown in Fig. 10. The fracture surface was cleavage in nature with chevrons pointing to the origin. The ductility, fracture pattern, and fracture surface were comparable to those exhibited by the many burst tests made at atmospheric temperatures (60° to 100° F).

Test A-2

Test A-2 was made on the other half of pipe A, again with flat heads. The pipe was cooled to minus 50°F and the burst test was completed with a final temperature of minus 48°F. A comparable yield strength to test A-1 was reached. However, the girth weld of the heavy flat head fractured before the ultimate strength of the pipe steel was realized. The bending stress at the root of the integral chill design due to stretching of the pipe caused premature failure through the girth weld. Fig. 11 is a view of this test. An average circumferential stretch of 0.63 in. was measured after the head was torn off. Eighteen inches were removed from the failed end of this pipe and semi-elliptical ASTM A212 Grade B heads were welded on and the pipe was retested as test A-2-1.

Test A-2-1

Test A-2-1, a retest of test A-2 was conducted with the pipe cooled to minus 49°F with a final temperature of minus 46°F at burst. The yield strength as measured by water column at 0.2 per cent volumetric set was increased approximately 6000 psi by the cold expansion of the previous test. The ultimate bursting stress as calculated was approximately 2000 psi higher than test A-1 on the other half of this pipe. An additional average 3 in. of circumferential stretch was produced in this test which again is normal ductility for similar pipe tested at atmospheric temperature. The additional cold expansion of the previous test has not impaired the ductility of this pipe as measured by the low-temperature burst test. The failure started ½ in. from the longitudinal seam near one end of the pipe and crossed this weld several times before encircling the pipe 5 ft. from the end and progressing into the head as shown in Fig. 12. The fracture surface was cleavage in nature with chevron markings.

Test C-1

Test C-1 was made on a 15-ft. length of X52 line pipe 30 in. diam x 0.344-in. wall received from customer storage in the Southern Illinois area. Semi-elliptical heads were welded to this pipe and the pipe was cooled to minus 52°F (in preliminary discussion of pipelines to be located in the colder regions of Canada, it was estimated that approximately 10 per cent of a line could be at temperatures estimated at —50°F for approximately 6 months of the year) with a final temperature at conclusion of the test of minus 48°F. The pipe exhibited a high yield strength as measured by the water column at 0.2 per cent volumetric set. Even though the calculated burst strength was 97,000 psi, the pipe stretched circumferentially an average of 4.82 in. which is greater than average stretch experienced during normal burst testing at atmospheric temperature. In over 2000 burst tests surveyed the maximum stretch ever measured was 6 in. on a burst pipe at normal atmospheric temperature. Fracture originated ½ in. from the longitudinal weld seam as shown in Fig. 13. The fracture surface was of a cleavage nature with chevron markings.

Test C-1-2

Test C-1-2 was made on a 19-ft. length of the same pipe as tested in C-1. A circumferential weld was made using field welding procedures* staggering the longitudinal weld seams approximately 18 in. Radiographs revealed some evidence of lack of pene-

*For low-temperature Charpy tests see data on AWS E7010.

Table II—Transverse Charpy Vee-Notch Tests—Expanded X52 Line Pipe

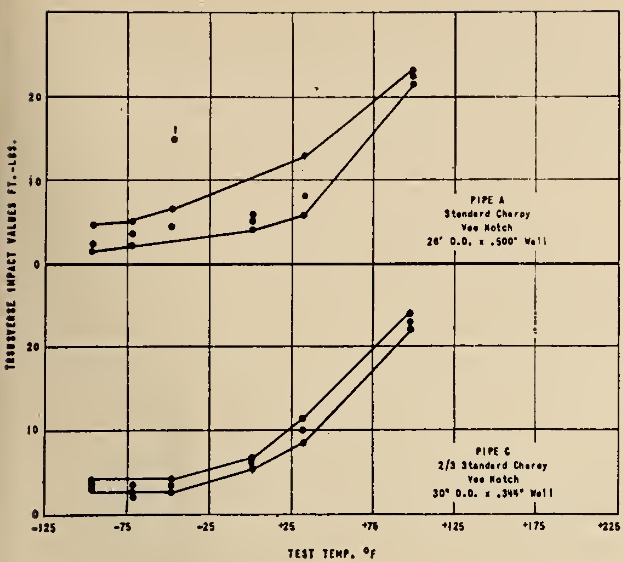
Pipe No.	*Size*	*Test Bar Size*	*212°F*	*100°F*	*32°F*	*0°F*	*−50°F*	*−75°F*	*−100°F*
A	26″ x .500″ Parent metal	Full		21.7	5.8	3.9	15.6*	2.3	2.6
				23.2	8.2	5.8	6.4	3.5	2.1
				23.2	13.2	5.4	4.3	4.8	4.7
A	Weld Zone	Full	30.5	30.0	16.8	13.9	9.5	3.7	6.2
			31.8	26.1	15.6	11.4	10.9	6.7	7.8
				35.0	14.2	12.4		5.9	7.9
C	30″ x .344″ Parent metal	2/3 Std.		22.1	11.1	6.5	3.9	3.1	3.4
				22.1	8.2	5.7	3.1	2.3	2.9
				24.0	9.9	5.5	2.5	2.1	2.6
C	Weld Zone	2/3 Std.		25.9	26.0	14.9	9.9	3.9	8.6
				26.1	24.6	14.2	9.0	8.8	7.8
				26.3	24.3	19.8	11.1	9.6	7.5
E	30″ x .500″ Parent metal	2/3 Std.	36.6	36.3	14.9	5.8	3.8		3.0
			44.6	34.1	8.8	5.2	3.4		2.2
			35.7	31.5	14.1	7.7	2.9		4.9
E	Weld Zone	2/3 Std.	41.3	38.8	20.7	13.7	11.4		10.7
			38.2	39.6	24.6	14.9	13.0		6.8
			39.6	40.5	22.5	15.6	14.4		9.9
F	30″ x .375″ Parent metal	2/3 Std.	25.7	20.3	9.8	8.7	4.3		2.2
			26.1	23.2	8.7	7.5	4.3		2.1
			25.7	25.3	10.6	9.2	2.1		2.0
F	Weld Zone	2/3 Std.	25.7	24.4	25.9	20.7	8.7		7.7
			26.1	26.1	23.1	18.6	10.6		7.8
			26.1	26.1	25.3	19.9	10.3		7.8

* Specimen interfered with pendulum—high value.

Table III—Burst-Test Data Line Pipe

Minimum Physical Properties of A. O. Smith X52 Line Pipe: 72,000 psi T.S., 52,000 psi Y.S. (Transverse), 46,000 psi Y.S.(Longitudinal)

										Strip Tensile Test Cut from Pipe			
Pipe Number	*Size*	*Heads*	*Test Temp.*	*Burst Pressure PSI*	*Ult Strength Calc. from Burst Pressure*	*Pressure at Yield .2% vol. Set*	*Calculated Stress at .2% vol. Set*	*Average Stretch*	*Fracture*	*Description*	*U.T.S.*	*Y.S. ½% Stretch*	*Elong. % in 2*
A–1	26″ x .500″ 15′ Long	Flat	0°F.	3175	82,500	2460	63,960	3.9″	3/4″ from Long. Weld Seam	Long. Stock	80,000	63,600	37.5
										Trans. Stock	82,700	68,300	34.0
A–2	26″ x .500″ 15′ Long	Flat	−50°F.	2725	70,850	2495	64,870	0.63″	Head Blew off	Heavy welded head blew off before pipe reached ultimate burst pressure. This stretched pipe 5/8″ in girth and semi-elliptical heads were welded on and pipe was retested as A–2–1.			
A–2–1	26″ x .500″ 13′-3″ Long	Semi-ellipt.	−50°F.	3260	84,760	2715	70,590	3.0″	1/2″ from Long. Weld Seam	This was a retest of pipe A–2. Note additional stretch of girth of 3″ in addition to 5/8″ during first test.			
C–1	30″ x .344″ 15′ Long	Semi-ellipt.	−50°F.	2225	97,020	1715	74,780	4.8″	1/2″ from Long. Weld Seam	Long. Stock	88,300	59,200	33.0
										Trans. Stock	90,600	61,400	28.0
C–1–2	30″ x .344″ 19′ Long	Semi-ellipt.	−50°F.	1950	85,020	1690	73,685	1.1″	In Long. Weld Seam	This was a test of pipe with a field girth weld.			
E–1	30″ x .500″ 15′ Long	Semi-ellipt.	—50°F. A 10,000 ft. lb. energy drop was made with pipe under pressure and at —50°F. prior to burst test at —50°F.	2540	76,200	2355	70,650	Not taken	In Long. Seam	Long. Stock	80,900	61,700	35.5
										Trans. Stock	81,800	64,500	32.0
F–1	30″ x .375″ 15′ Long	Semi-ellipt.	182°F.	2025	81,000	1535	61,400	3.0″	4″ from Weld	Long. Stock	85,500	60,100	32.5
										Trans. Stock	85,700	64,400	31.5



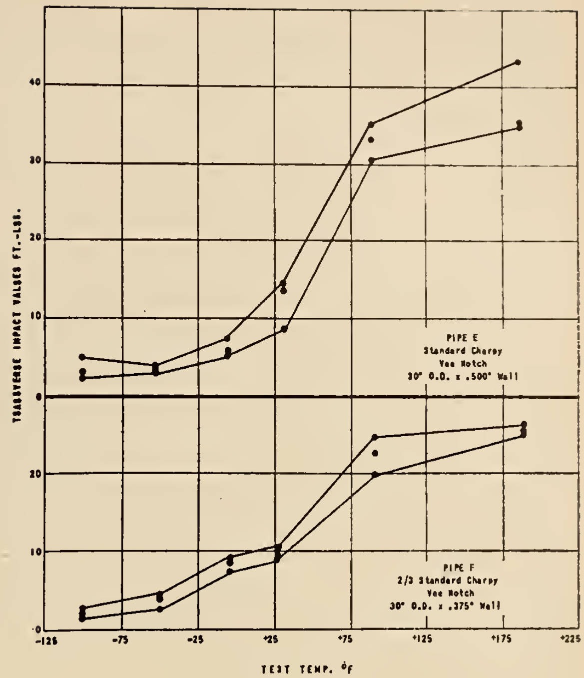


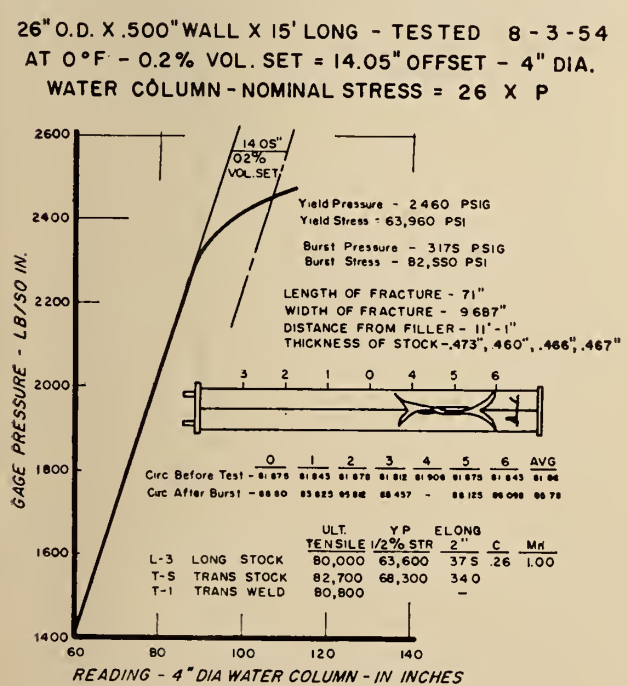
Fig. 2. Ductility-transition temperature curves of X52 line-pipe steel. (Pipes A and C, above; pipes E and F, right.)

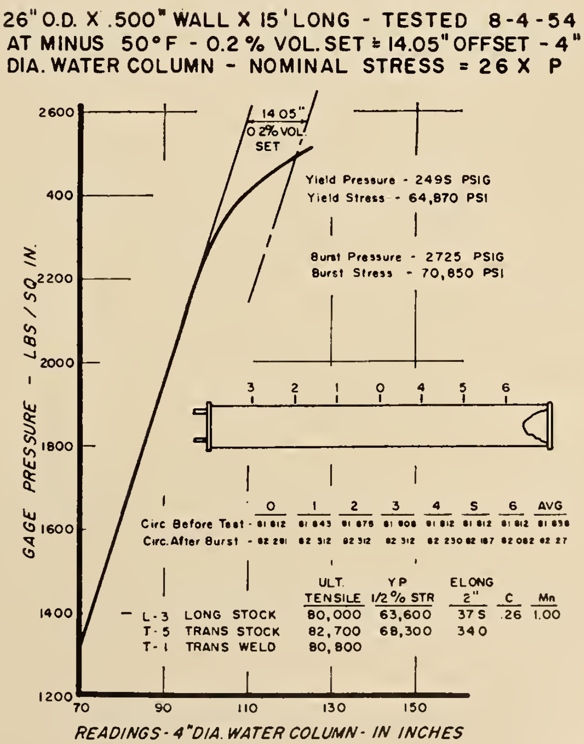
tration which was judged acceptable by Standard API 1104. Semi-elliptical heads were welded to this pipe. The pipe was cooled to minus 49°F and at completion of test the temperature was minus 46°F. Fracture started in the longitudinal seam 4 in. from field girth seam and ran into one head and, in the other direction, the fracture proceeded through the field girth seam and then encircled the pipe as shown in Fig. 14. The yield strength was equal to that determined in test C-1. The ultimate bursting strength was lower than that of the other end of this pipe (test C-1) but was 18 per cent greater than the minimum ultimate strength specified (72,000 psi). A circumferential stretch of 1.1 in. was recorded on both sides of the girth seam and ⅞ in. on the field weld. The fracture surface was of the cleavage type with chevron markings.

Test E-1

Test E-1 was made on a 15-ft. length of X52 line pipe 30 in. diam. x 0.500 in. wall with welded-on semi-elliptical heads. This pipe was shipped from customer storage in Southern Texas. The pipe was cooled to minus 50°F and a semi-elliptical tup weighing 750 lb. was dropped from

Fig. 3. Water-column curve of burst test on pipe A-1.
Fig. 4 (right). Water-column curve of burst test on pipe A-2.





a height of 13 ft.-4 in. to impart 10,000 ft-lb. energy to the pipe which was at a pressure simulating the working pressure. A saddle made from a cutout from a 30-in. x 0.344-in. wall pipe was placed at the point of impact to prevent gouging of the test pipe. The drop of the tup was made over the longitudinal weld seam of the test pipe. Extra-heavy pipe nipples with high-pressure valves were provided at both inlet and outlet of the test pipe so that working pressure could be maintained. The drop of the tup severely gouged the saddle with no apparent damage to the test pipe. Both extra-heavy nipples broke from the heads as a result of the impact with subsequent escape of the cold brine.

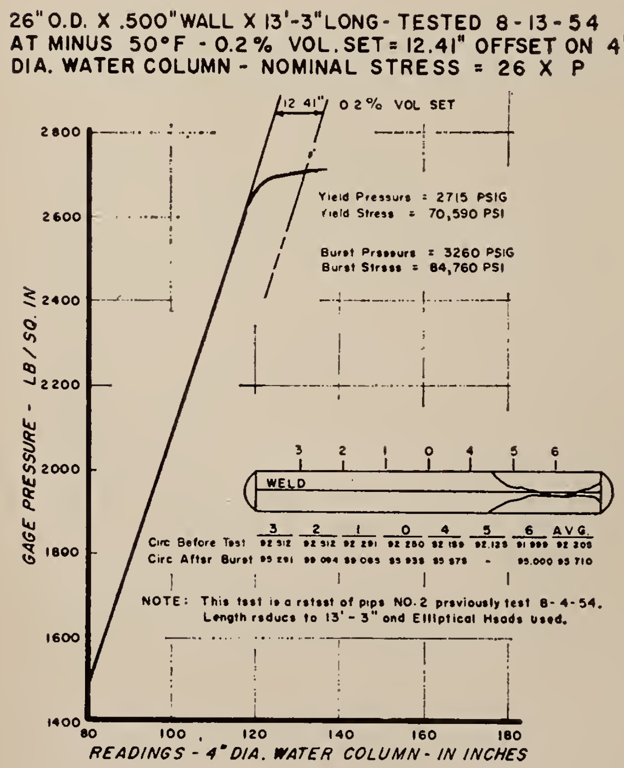
After the piping system was repaired the pipe was cooled to minus 50°F and a burst test was made. The temperature was minus 47°F at completion of the test. The yield strength as determined by the water column at 0.2 per cent volumetric set was several thousand psi higher than determined from transverse strip tensile tests which could be due to expansion caused by surge of pressure during the drop test. Even though the pipe was subjected to a severe shock at sub-zero temperature, the burst strength was 6 per cent above the minimum ultimate strength specified (72,000 psi). Fig. 15 is a view of this pipe. Fracture started in the longitudinal weld seam and progressed along the seam through the head until a section of the pipe was blown out. Fracture surface was cleavage with chevron markings throughout including the ¾-in-thick ASTM A212 killed-steel heads.

Test F-1

Test F-1 was made on a 15-ft length of X52 line pipe 30 in. diam. x 0.375 in. wall with welded-on semi-elliptical heads. It was desired to produce a shear-type fracture and a test temperature of plus 180°F was selected. The water in the tank was heated and circulated through the pipe until a temperature of plus 182°F was reached. At this point the burst test was started and final temperature at the completion of the test was plus 179°F. The pipe exhibited calculated yield and ultimate burst strengths nearly equal to those determined from transverse strip tensile tests. The circumferential stretch after burst averaged 3.0 in. Fracture started 4 in. from the longitudinal weld seam and is shown in Fig. 16. The fracture was characteristic of a 45-deg. shear type without chevrons.

Summary

It was determined that the data secured from burst tests of X52 grade line pipe at subzero temperatures was within the normal range of tests conducted at atmospheric temperatures. The pipe exhibited the same ductility when burst tested at subzero temperatures as at normal atmospheric temperatures. The fracture appearance after burst testing at subzero temperatures was cleavage with chevron markings the same as when tested at atmospheric temperatures. The carbon equivalent had no apparent effect on the performance of the individual pipe in the burst tests or the notch-bar tests. It is difficult to correlate the performance of the pipe with the Charpy vee-notch specimens of the material based on some arbitrary value of energy between the upper and lower plateaus of the energy-temperature transition curve, as measured by the Charpy vee-notch bar. It is significant that whether the pipe is to be in service at +40°F where there is the longest service record or at 0°F, the steel is on the lower plateau of the energy-temperature transition curve. To obtain shear-type fracture in the burst test the results of a single test at plus 180°F would indicate that the pipe should be at a temperature which is well up on the upper plateau of the energy-temperature transition curve. The average circumferential stretch of the pipe burst at plus 180°F was no greater than that obtained in atmospheric or subzero temperature tests. Shear-type fractures in semi-killed steels have not been obtained to date on line-pipe burst tests at atmospheric tempera-



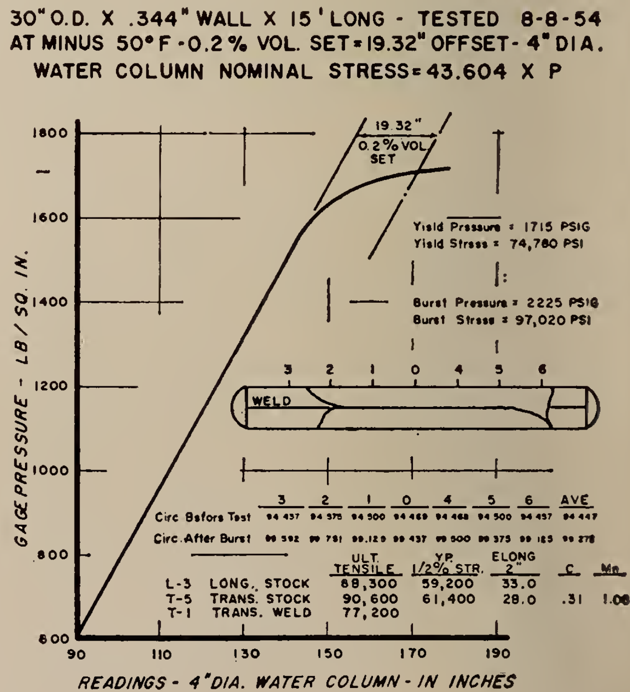


Fig. 5 (left). Water-column curve of burst test on pipe A-2-1.
Fig. 6. Water-column curve of burst test on pipe C-1.

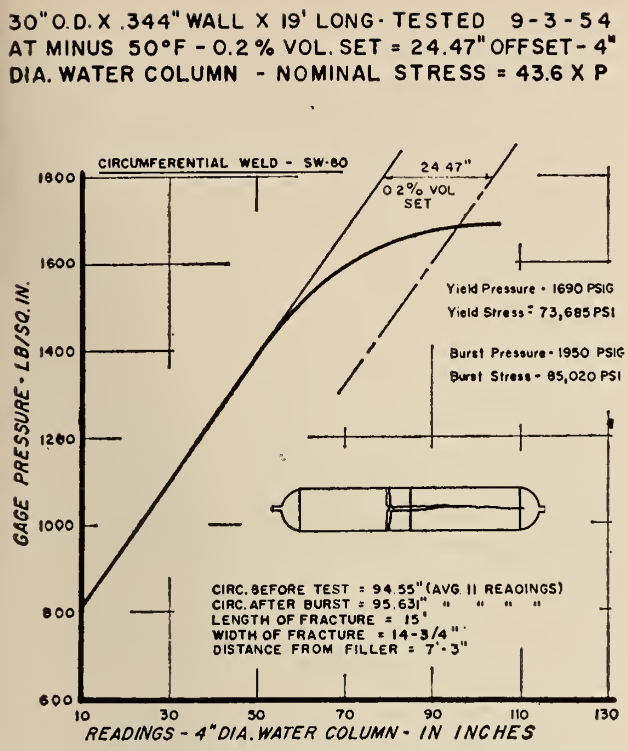


Fig. 8 (left). Water-column curve of burst test on pipe E-1.

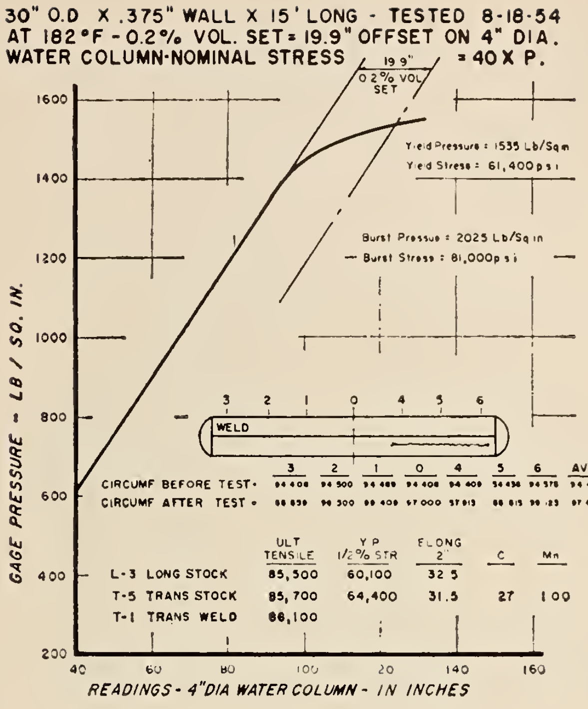


Fig. 9. Water-column curve for burst test on pipe F-1. (Above, right)

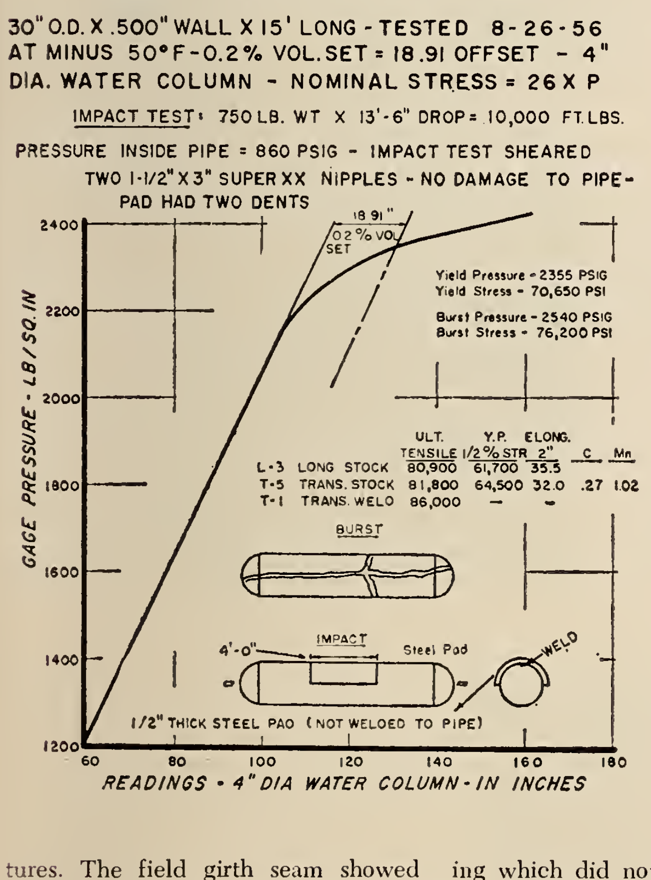


Fig. 7. Water-column curve of burst test on pipe C-1-2.

tures. The field girth seam showed ductility as measured by the stretch during burst testing at minus 50°F. No attempt was made to place artificial notches in the pipe tested; however, in some of the pipe tested there were defects up to 12½ per cent of the wall thickness such as chain marks, score marks, and gouges due to handling which did not affect the test results. None of the pipe burst at 0° or —50°F had any tendency to shatter.

Based on the foregoing test results of flash-welded line pipe, together with several —50°F burst tests of special silicon-aluminum killed low-carbon steel and low alloy-high tensile proprietary steels*,† all submerged arc welded, we conclude the following:

Regardless of the Charpy transition temperature of the parent metal, of great differences between the longitudinal and transverse transition temperature (variation of +10° to +60°F at 10 ft-lb. for 2/3 standard Charpy vee-notch tests), the performance of all pipe tested was comparable and equivalent to burst tests made at normal atmospheric temperatures. All burst fractures were of the cleavage type with chevron markings, and no shattering occurred.

Ductility of the steel at —50°F is shown by the elongation or stretch of the circumference of the pipe tested. This amounted to more than 2.6 in. for the 20 in. x 0.375 in.‡ special killed steels, and over 2.6 in. for 26 in. x 0.500 in. and 30 in. x 0.344 in. flash-welded X52 grade steel line pipe. All pipe tested at —50°F developed in excess of the minimum mechanical properties of yield and tensile strength required for X52 expanded line pipe.

These facts give support to our

*"Yesterday, Today, and Tomorrow — Pipeline Steels," by A. B. Wilder and A. F. Sebersold, ASME Paper No. 56-A-97.

†"Evaluation of the Significance of Charpy Tests for Quenched and Tempered Steels," by P. P. Puzak and W. S. Pellini, The Welding Journal, vol. 35 (6) Research Supplement, 1956, pp. 275s-290s.

‡Metallurgical Research Laboratory Report, A. O. Smith Corporation, August 22, 1955.

Fig. 10 (left). Burst tested pipe A-1.

Fig. 11. (above). Burst tested pipe A-2.

Fig. 12. Burst tested pipe A-2-1.

Fig. 13. Burst tested pipe C-1.

Fig. 14. Burst tested pipe C-1-2.

engineering judgment on the use of special low-temperature steels for low temperature service conditions. We believe that it is more economical to use commercial semi-killed steel of Grade X52 but to exercise greater care in the field operations of welding and trenching pipe than it is to procure, if possible, a steel which would insure more notch toughness as insurance against the bad defect in the field that can cause a blowout burst. This amounts to increased supervision and inspection prior to covering the pipe to prevent sharp, crack-like defects.

Fig. 15. Burst tested pipe E-1.

Fig. 16. Burst tested pipe F-1.

It has been stated in the many reports of the Ship Structure Committee that to replace all the steel necessary for the large shipbuilding program of World War II with hot-topped killed steel, with a lower transition temperature, would have been impossible because of the lack of facilities in the steel mills to make this quantity of killed steel properly.

The user of line pipe for low-temperature service should consider carefully the standards of inspection he is maintaining in the field to lay pipe —if these are not adequate from the concept of the metallurgical hazard due to the notch effect he would do his company great good by improving these standards accordingly.

Acknowledgments

In the preparation of the foregoing series of papers under the general subject of "The Metallurgy and Cold-Temperature Testing of Flash-Welded X52 Pipe," the authors wish to acknowledge the co-operation received from Mr. H. F. Detrick, vice-president in charge of petroleum products and for permission from the officials of the A. O. Smith Corporation to publish these papers. They also are indebted to many others who did much useful work in making this series of papers possible. We wish to especially thank the following: R. A. Huseby, metallurgical engineer, Research and and Development Division; H. Ebling, metallurgical engineer, Research and Development Division; W. Hoppe, mechanical engineer, Tubular Products Division; E. J. Limpel, director of Electrical Research, Research and Development Division; J. J. Chyle, director of Welding Research, Research and Development Division.

The F.N. Rifle

R. Patterson,

Technical Manager, Small Arms Division, Canadian Arsenals Limited.

The F.N. rifle was adopted by several nations as standard for service use, and its manufacture has been undertaken by various countries, including Canada. A major operation was the conversion from Belgian standards and drawings to Canadian practice. The paper indicates the complexity of the work involved. Similar problems might be found in the adaptation of other equipment from European standards.

FABRIQUE NATIONALE d'Armes de Guerre, Société Anonyme, is a private company, located at Herstal-lez-Liège, Belgium, which has specialized for many years in precision engineering products such as small arms, ammunition, A.A. guns, motorcycles, military vehicles, and so on, and has a long experience in dealing with government contracts of all kinds.

The Company was founded in 1889, by a group of Liége gunsmiths, to manufacture the Mauser 89 Rifle for the Belgian Army. Later on, this activity was extended to cover hunting and sporting weapons, and an agreement was entered into with the American inventor, J. M. Browning, for the manufacture of weapons of his design. It was thus that the first automatic pistol in the world came to be manufactured in the Fabrique Nationale (F.N.) factories at Herstal. This was followed by many other weapons of F.N. and Browning design, which were put on the market.

Modern warfare has brought about many changes in military tactics, necessitating the design and development of equipment, weapons and strategic stores to meet the altered role. With this thought in mind and with their wide experience Fabrique Nationale developed and produced a new light automatic rifle which became known as the F.N. (Fig. 1.)

At about this time allied nations, realizing that to unify forces most effectively ammunition and weapons should be made common, formed an International Small Arms Ammunition Committee and in 1953 officially announced the adoption of a standard 7.62mm. (.30 calibre) small arms round.

This decision initiated comparative firing trials of various rifles presented by several nations for test. In this demonstration, the F.N. rifle was conspicuous in design, performance and target accuracy. The collaborating countries were so impressed with the possibilities of the prototype weapon that production rifles were obtained for more rugged troop and engineering trials and extensive programmes were undertaken to prove thousands of the rifles under the adverse conditions encountered in the snow and sub-zero temperatures of the Arctic, the heat and humidity of the tropics and the sands of the deserts.

The results of these trials were favourable and several countries were quick to accept the F.N. type rifle for national service use. By international agreement and as a result of the field trials in extreme climates and the different tactical doctrines of the countries involved, the basic weapon only was adopted by collaborating countries, with each country being permitted to adopt "national preference items" which best suited its particular purpose and desirable military characteristics as long as interchangeability of parts was not affected. This "national preference" policy can best be described by saying that, though parts must be interchangeable individually or as assemblies, the portion which "fits air" can be designed to meet the service needs of the individual country.

This basic F.N. rifle is an air-cooled, gas-operated, magazine-fed, self-loading weapon having an adjustable gas regulator to ensure smoothness of operation without excessive recoil. (Fig. 1.)

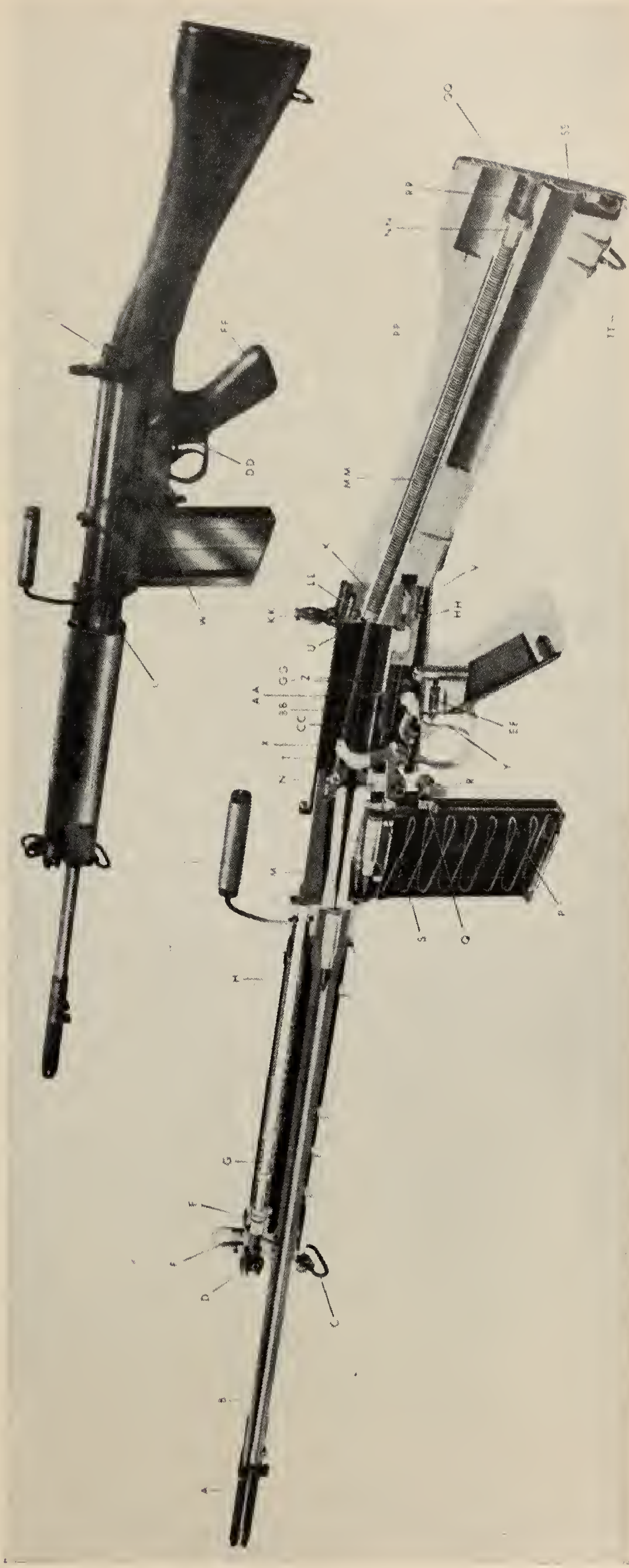
The breech block is mechanically locked before firing and is not unlocked until the bullet has left the barrel. Since the breech block is in the forward or closed position when the trigger is pressed, there is no disturbance of the shooter's aim by a heavy mass moving forward.

After firing, the mechanism extracts the spent case from the chamber, ejects the case laterally to the right and slightly forward of the shooter, then feeds a new round from the magazine into the chamber, recocking the hammer in the process thus leaving the rifle in readiness for firing again.

When the magazine is empty, the recoiling parts are held in the rear position by a holding-open device, indicating to the shooter the need to reload or replace the magazine, and providing maximum convenience for the purpose, since it requires only the release of the holding-open catch after reloading to have the rifle once again in readiness for immediate firing.

To serve international interests a "rifle steering committee" was set up. This committee, made up of service, design and production representatives of the countries involved, meets regularly and is chaired by Canada, since Canada was selected as the "design authority". As the "design authority" Canada was made responsible for engineering investigation and compiling a set of "inch standard

Fig. 1. General and sectional views of the FN rifle.



A. Flash eliminator
B. Barrel
C. Front sling loop
D. Gas plug
E. Gas regulator
F. Foresight
G. Piston
H. Handguard
J. Carrying handle
K. Body
L. Cocking handle
M. Breech block carrier
N. Body cover
P. Magazine
Q. Holding open catch
R. Magazine catch
S. Safety sear
T. Return spring compressing rod
U. Rod plunger
V. Trigger mechanism housing
W. Hinge pin locking screw
X. Hammer
Y. Trigger
Z. Locking plate

AA. Change lever stem
BB. Hammer spring assembly
CC. Sear
DD. Change lever
EE. Trigger plunger
FF. Pistol grip
GG. Change lever retaining ring
HH. Body locking catch
JJ. Locking catch lever
KK. Backsight
LL. Backsight zeroing screw
MM. Return springs
NN. Return spring tube screw
PP. Butt
QQ. Butt plate
RR. Butt plate screw
SS. Butt plate trap
TT. Rear sling loop

drawings" suitable for mass production of the rifle by modern North American manufacturing methods, then finally, on behalf of the Rifle Steering Committee, striking out a master set of basic rifle component and assembly drawings to control interchangeability and standardization of design. The Directorate of Armament Development, Department of National Defence (Army) Canada, assigned the programme of conversion to Canadian Arsenals Limited for fulfilment at their Small Arms Division, in Long Branch, near Toronto.

It was decided that since weapon design was being standardized it was an opportune time to combine a unified drawing standard. Accordingly, the design authority specified the Canadian Standard CSA-B78.1-1954 along with the British Standard BS 308-1953 as a supporting step toward the development of an International and Unified ABC (America, Britain, Canada) Drawing Standard. The result is that the "inch standard" drawings referred to remove the problems resulting from the use of different drawing practices with varying methods of projection, terminology, tolerances, geometrical expressions, machining, and roughness symbols.

Fig. 2 shows examples of symbols of basic tolerances, and Fig. 3 symbols of surface finishes, used on Fabrique Nationale drawings. Figs. 4, 6, and 8 compare F.N. and "inch standard" drawings for three parts of the rifle. The F.N. and CAL version have been redrawn, for better reproduction, but follow the originals closely. Figs. 5 and 7 are photographs of various components.

As Canadian Arsenals up to this time was accustomed to working with both British and American designs expressed in the earlier conventional methods, the new system now undertaken required a programme of study and education.

Due to the urgency and time limit set for the completion of this work, it was necessary to streamline the preparatory approach to acquaint the drawing office staff with the new drawing system. Accordingly, senior engineers undertook the primary study of the B78.1-1954 mechanical engineering drawing standards book and compiled from this a simplified manual as a local design practice. Where the formal book gave examples of methods of presenting features together with approved alternatives the engineers selected one presentation only for each expression and showed this in the local manual. Information, pertinent only to work on hand, was entered for use.

The rifle was then classified into four major sections, namely: barrel assembly, body assembly, action parts, and butt assembly, and a senior designer was assigned to each section with a group of the draughting staff under his jurisdiction for guidance and completion of the required drawings in accordance with the manual issued. The official standards book was retained by the senior as a reference. With this breakdown the concept of the new practice was readily acquired and the work progressed with reasonable speed to produce the full set of basic drawings.

In accordance with the manufacturing agreement. Fabrique Nationale supplied their complement of drawings with engineering notes. As the Belgian data and method of drawing practice differs widely from the conventions commonly used on this continent, the first step was detailed perusal to ensure a true interpretation of all information. A translation of the French inscriptions and engineering notes on each drawing was made and attached to the respective original F. N. print. Examples of the Belgian practice and of final conversion to inch measurements are shown in Figs. 4, 6, and 8.

It was essential also to make a comprehensive simile in English text of all the F.N. general specifications, instruction sheets, tables, charts, and symbols explaining the principles and application to the drawings on hand. Examples of some of the symbols employed and their significant values are shown in Figures 2 and 3.

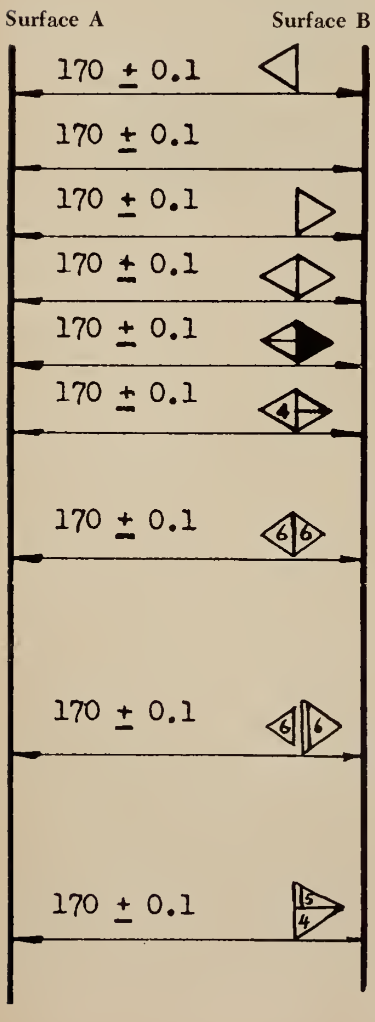
The first drafting board action was to make pictorial transpositions from the first angle projection method used on the Belgian prints to third angle projection on tracing material but without any ascribed dimensions. From these transposed tracings two sepia or brownline prints were taken. On one, the metric dimensions were added after being converted to have unilateral tolerances including the calculated values implied by the symbols and supplementary directions prevalent on the original F.N. print. Some refinements of presentation were made, such as sectional views, etc., as needed for clarification.

The second sepia print known as the "inch replica" was in turn brought in line carrying the same corresponding dimensions but converted from the metric system to inch measurements, to conform to North American standards and thus simplify tooling, gauging, and so on. This then was a direct reading drawing illustrating the requirements of a finished component part, fully dimensioned for size and tolerance without resorting to by-notes and indirect tool allowance calculations. (Figs. 4, 6, and 8.)

At this stage a "tool room" model rifle was made up by Canadian Arsenals to prove dimensions and functioning of an equipment manufactured to the converted drawings.

Fig. 2. Examples of symbols of basic tolerances to be accorded to the profile of a tool (Fabrique Nationale drawings). The tolerance expressed by the symbol which is adjacent to the dimension on the drawing is to be calculated from a table of formulae.

Fig. 3. Examples of symbols of surface finishes.



Meaning

Face A (coarse finish)
Face B (ordinary finish)

Face A and B (ordinary finish for both)

Face A (ordinary finish)
Face B (coarse finish)

Face A and B (coarse finish)

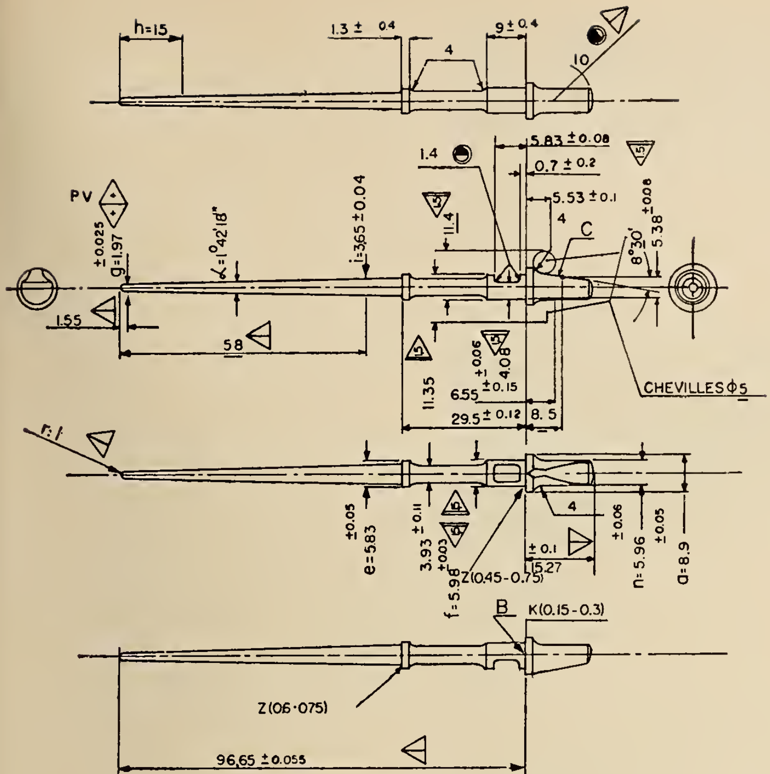
Face A (fine finish)
Face B (perfect finish)

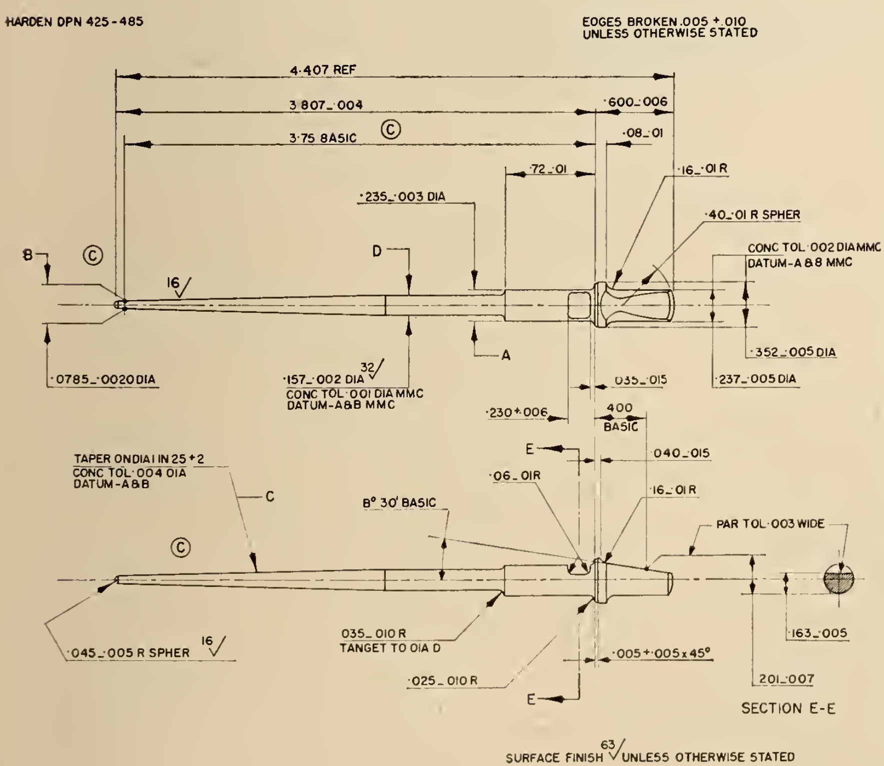
Face A (polishing finish) permissible removal of metal 0.04 mm.
Face B (fine finish)

Face A (polishing finish) permissible removal of metal 0.06 mm.
Face B (polishing finish) permissible removal of metal 0.06 mm.

Face A (polishing finish) permissible removal of metal 0.06 mm.
Face B (polishing finish) obligatory removal of metal 0.06 mm.

Face A (ordinary finish)
Face B (polishing finish) obligatory removal of metal 0.05 mm. and permissible additional removal of 0.04 mm.





ACTUAL SIZE
OF PIECE

Fig. 4. Drawings of the F.N. firing pin. Top. the F.N. drawing; centre, the Canadian Arsenals Limited (CAL) drawing; bottom, actual size of part. The following instructions are appended to the F.N. drawing.

Instructions spéciales pour la fabrication de cette pièce.

P.V.	(1) Le plan axial vertical P.V. conseillé par le dimensionneur est celui qui passe par l'axe de la pièce et est perpendiculaire au plan contenant la
C	face C.
	(2) Excentricité admissible par rapport à l'axe matérialisé par le centrage
f	simultané sur la partie de ϕf et sur la partie immédiatement voisine de la pointe:
e	de la collerette de ϕe: 0,02
a	de la collerette de ϕà: 0,01
n	de la partie de ϕn: 0,01
i	de la partie de ϕi: 0,02
r	(3) La pointe de rayon r aura la forme d'une demi sphère aussi parfaite que possible. Elle sera réalisée par rectification *aprés trempe.*
h	(4) Dans la partie de longueur h ◇ aucune trace de rectificationne peut plus subsister après polissage.
g	Apres celui-ci la tolérance accordée à la cote g peut attendre: +0,015; −0,055.
a	(5) Sur pièce finie trempée, le minimum de la cote a peut descendre jusque 8,8.
B	(6) La face B sera parfaitement perpendiculaire à l'axe de la pièce.
α	L'angle α est donné à titre indicatif.

Remarque: Pour la finition des surfaces et la toilette de cette pièce voir les feuilles "Conventions relatives à la toilette des pièces d'armes".

The "inch replica", now representing the true proportions of the F.N. design, was turned over for study from a process and tooling aspect to determine the nearest suitable inch sizes for North American procurement and practice. Holes were considered for preferred inch diameters in keeping with suppliers' catalogues of drills, reamers, and other tools. Pins, rods, etc., were compared to the regular sizes common to the general mill run of bar stock selections. A close observation was made of datum surfaces with a thought to substantial bearing locations when making machine cuts and gauging. During this survey, the "inch replica" drawing was marked to show the recommended choice against each respective detail. In the case of screws and threads the Unified Thread Standard was applied throughout. Included also during this phase of the work was a complete review of the material specifications to tie in with North American supply

Fig. 5. Above, from top: body, block breech, and carrier of the F.N. rifle, illustrate typical parts on which machining operations are carried out.

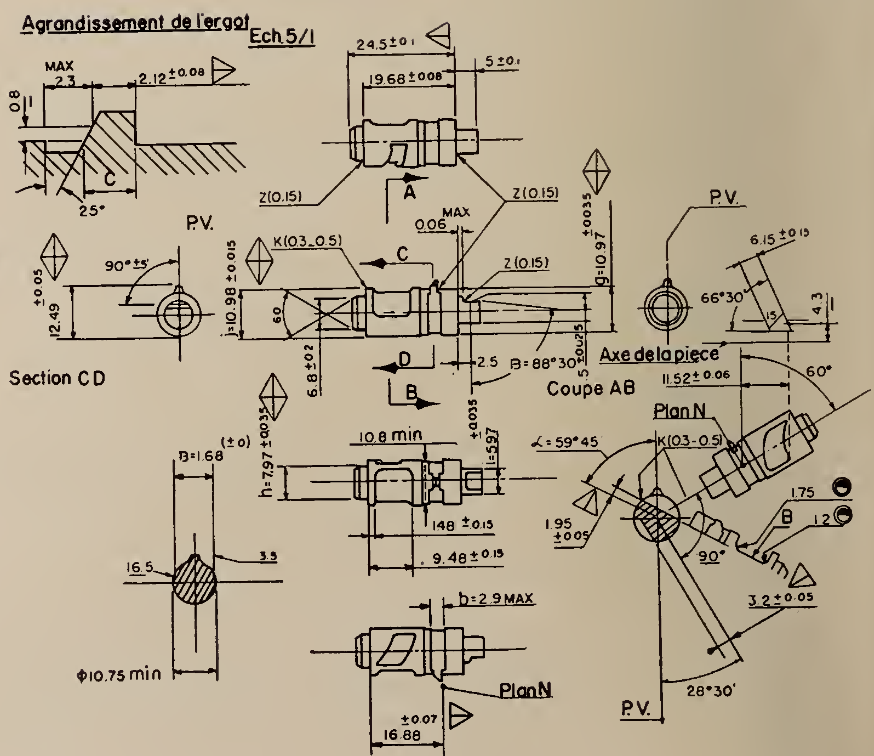
and where possible improve machinability or the strength of the component. Typical examples of substitute or material changes follow.

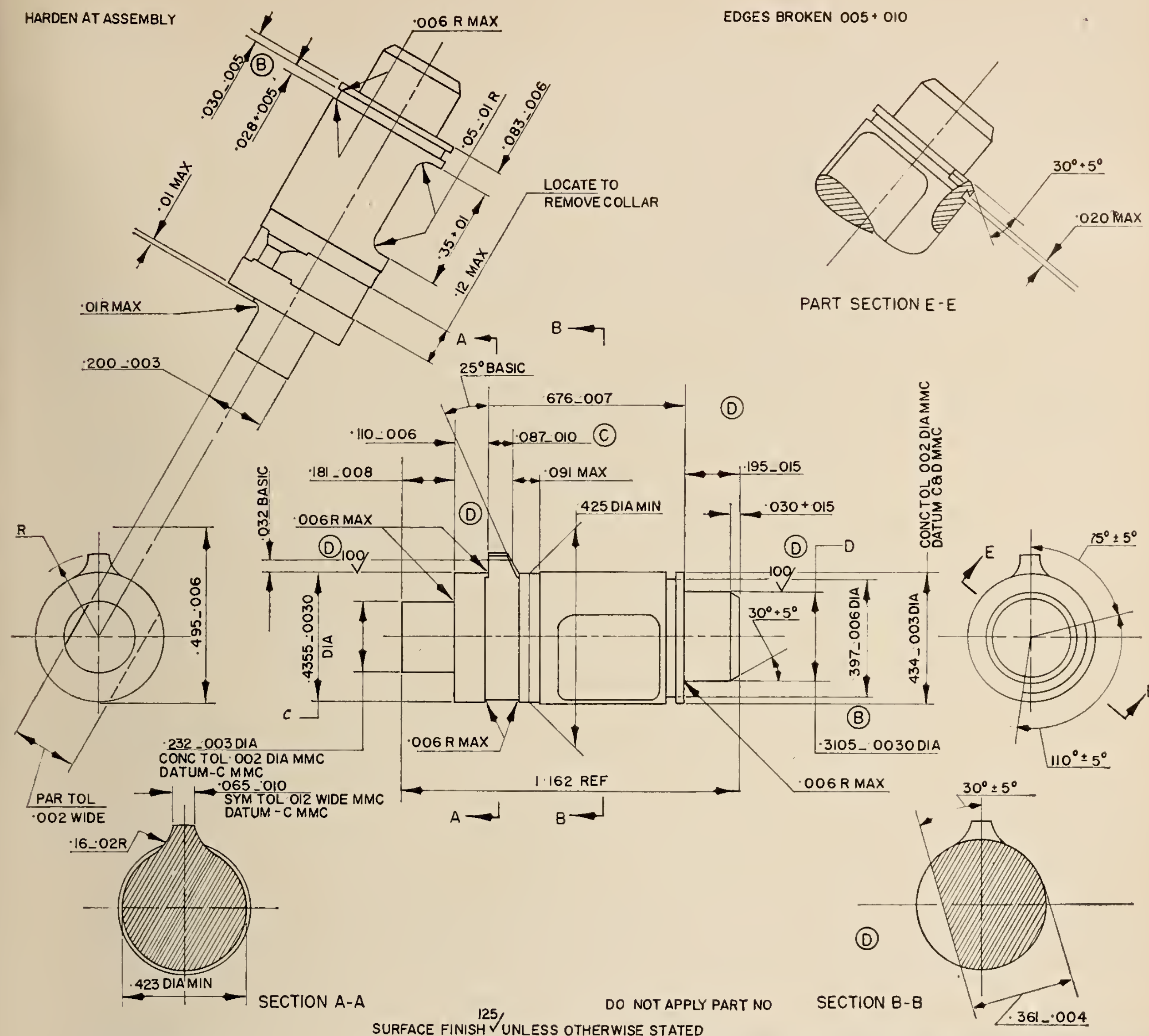
The 1% chromium type steel assigned by F.N. for the barrel was replaced by a 5% nickel steel, the purpose being to utilize the experience developed over the years in deep hole drilling, reaming, and broach rifling techniques which were well-proven during the manufacture and service of the Bren gun barrel using this identical material. A nickel-chrome-molybdenum steel was recommended for several components displacing the plain carbon type steel previously used. On these particular applications the Ni-Cr-Mo steel is heat treated to a hardness of 245 to 300 D.P.N. prior to machining and in this condition has a yield strength factor higher than plain carbon steel but the machinability ratings are comparable. Because of the increased physical characteristics there is less tendency for wear and pick-up on slide friction surfaces and it is unnecessary to harden these wear points locally thus avoiding warpage and subsequent straightening. The presence of alloying elements also tends to increase the corrosion and erosion resistance of the surfaces exposed to the effects of the gases generated.

For some groups of components it was deemed beneficial to up-grade or substitute direct-hardening materials for case-hardening class steels and vice versa, according to the nature of the stresses involved. Economy also had a direct influence in these evaluations.

Early collapse of springs functioning in close proximity to the hot gases operating the weapon was apparent. A series of tests on four types of spring wire was conducted to compare the deflection under load at temperatures varying from 200 F. to 1000 F., in increments of 100 F. Specimen springs made of plain carbon, chrome-vanadium, and two classes of stainless steel wire were used. The test results, plotted in graph form, showed the comparative merits of each example. Heat resisting stainless steel (also specified as steel, wire corrosion resistant) proved most satisfactory and capable of rendering long service in the elevated temperature conditions.

Sand and mud, which inevitably enter the mechanism of a rifle in operational use, have always presented





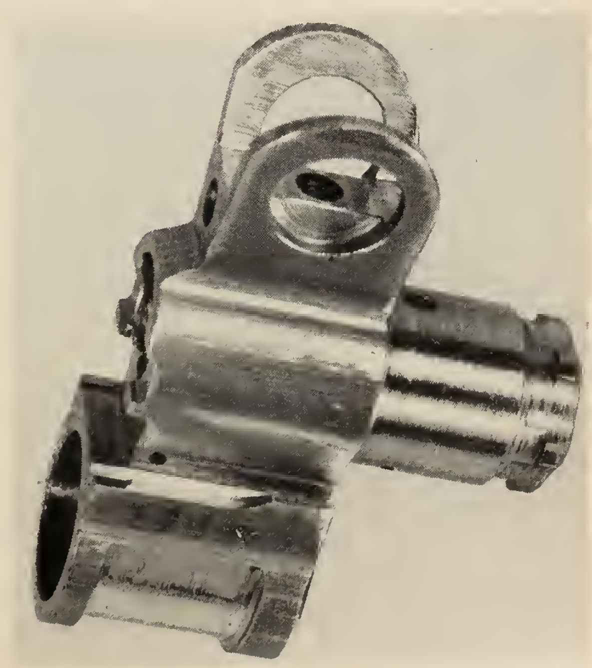


Fig. 7. Right: block, gas of the F.N. rifle. ►

Fig. 6. F.N. change lever stem. The F.N. drawing is on page 76, the CAL drawing above, and the small diagram shows the actual size of the part. Instructions on the F.N. drawing are:

Instructions spéciales pour la fabrication de cette pièce.

P.V.α j, B	(1) Le plan axial vertical P.V. fait un angle α avec le plan qui passe par l'axe de la partie cylindrique de diàmetre j et est parallèle à la face B.
P.V. a	(2) Décalage admissible par rapport au P.V. de la largeur a ±0,15.
b c	(3) La gorge de largeur b sera bien repartie à vue par rapport à l'ergot de largeur c.
i-g	(6) Excentricité admissible de la partie de diamètre i par rapport au corps de diamètre g 0,03.
h-j	(7) Excentricité admissible de la partie de diamètre h par rapport au corps de diamètre j 0,01.
β	(8) L'angle β est important.

Remarque: Pour la finition des surfaces et la toilette de cette pièce voir les feuilles "Conventions relatives à la toilette des pièces d'armes".

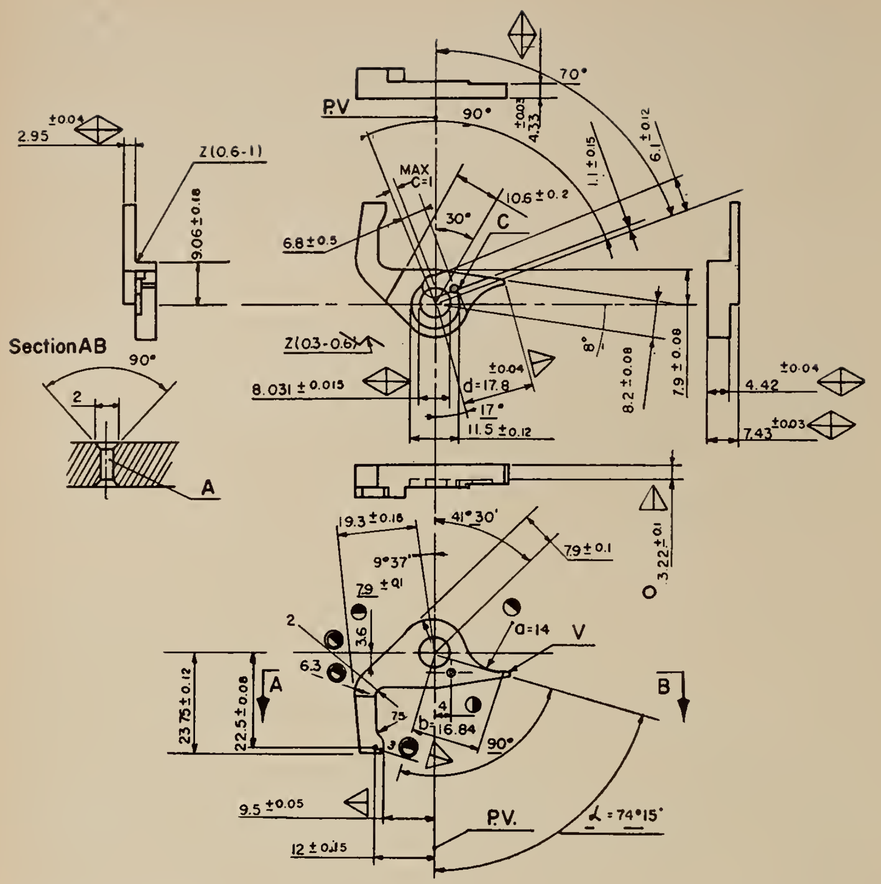


Fig. 8. F.N. safety sear. F.N. drawing, left; CAL drawing, below left; actual size of piece, below. The instructions on the F.N. drawing are:

Instructions spéciales pour la fabrication de cette pièce.

P.V. α a b — (1) Le plan axial vertical P.V. fait un angle immuable α avec le plan qui passe par le centre du trou et est tangent à la courbure de rayon a à l'endroit localisé par la cote b.

A — (2) Le trou A sera simplement foré avec une mèche de ϕ 1,1.

c — (3) La cote c ne devra pas écarter exagérément de la valeur indiquée.

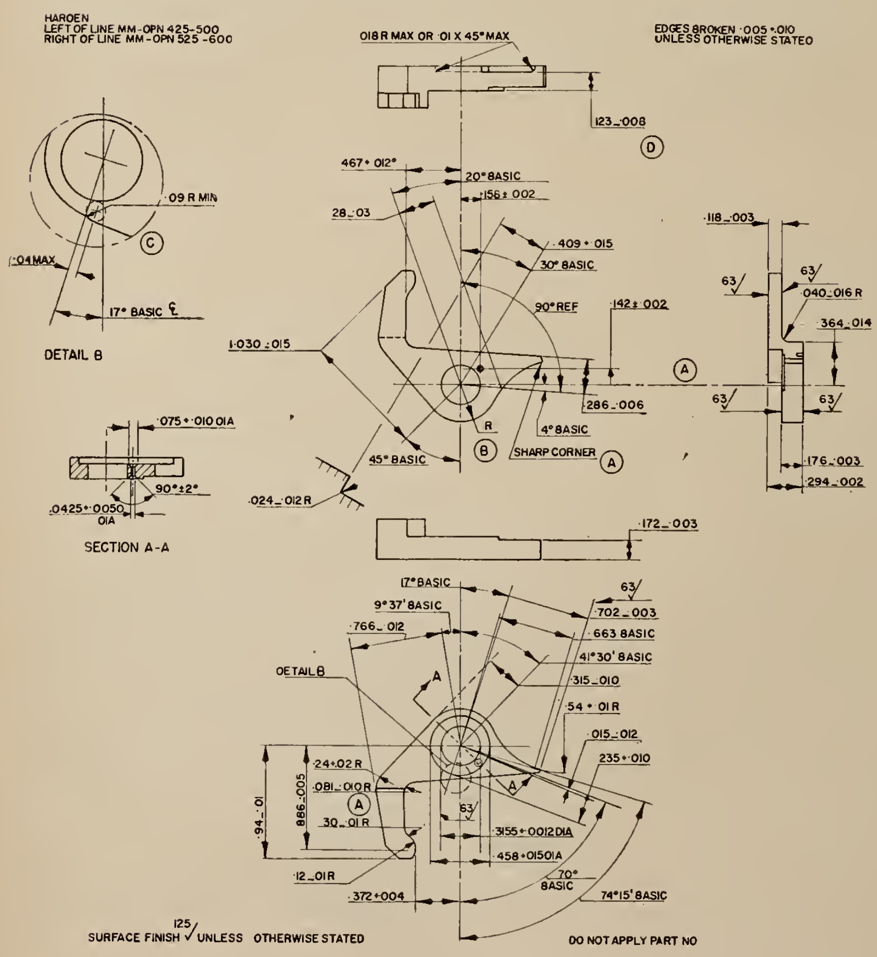
o — (4) La cote marquée o localise des faces qui sont représentées sur un même niveau, mais qui sont effectuées en plusieurs operations. L'affleurement entre ces diverses opérations n'est pas exigé et des dénivellations sont permises dans les limites de la tolérance indiquée.

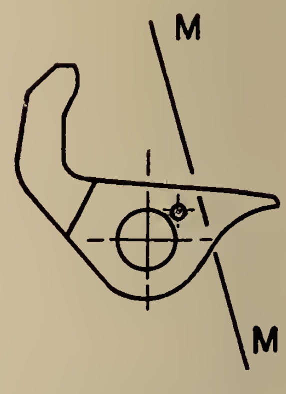
V — (5) L'arête marquée V sera laissée aussi vive que possible.

d — (6) La cote d s'entend pour une rectification après trempe.

C — (7) L'arête C pourra être altérée fortement par suite de l'opération de chanfreinage du trou A ou préalablement à cette opération pour la faciliter.

Remarque: Pour la finition des surfaces et la toilette de cette piece voir les feuilles "Conventions relatives à la toilette des pièces d'armes".





ACTUAL SIZE

a challenge to weapon designers and manufacturers. The advancement in hard chrome-plating technique offers some relief to this problem as, in recent years specialists in the electroplating field have developed processes adequate for plating the full length of the bore and chamber of rifle barrels with a reliable degree of accuracy control to maintain the desired precision of size and contour.

Barrels treated by this method give improved performance as the plated chamber surface resists indentation of

(*Continued on page 85*)

Important Applications of Heat Storage in Industry

W. Goldstern,

Steam Storage Company Limited, Leeds, England, and Toronto, Ont.

HEAT STORAGE AS A basic principle has been known and applied by engineers for many centuries. Steam storage was first introduced as a practical solution by Professor Rateau for the use of exhaust steam in low-pressure turbines, mainly in collieries and steelworks. Dr. Ruths developed the high-pressure accumulator for balancing the boiler load and opened-up the great field of steam-using industries, such as paper mills and surgar refineries, but at the same time restricted its economic value by greatly overrating the size of plant required. During the last few years, various improvements have been made both in respect of technical design and economical application.

In an article "Some Important Applications of Heat Storage in Industry" (*Fuel Economy Review*, 1954*), the author illustrated five typical heat storage installations which embody these principles of reduced cost and improved performance. The examples ("cases") used were: (1) steam storage for peak demand; (2) balancing boiler load; (3) boiler-accumulator; (4) hot-water storage; (5) storage of exhaust steam. The present article also appeared in *Fuel Economy Review*, 1957 (published by the Federation of British Industries).

IN A PREVIOUS article,* heat storage was explained by five typical applications. In various other industries heat accumulators have been installed for similar purposes, and in fact many new applications are found every year. The basic principle that steam and heat can be stored is still not sufficiently appreciated and it is hoped that the following five further examples may help to show the great possibilities.

Case 6: Indirect Balance of H.P. Peaks

The Problem

It is obvious that a steam accumulator between boiler and low-pressure (L.P.) consumers can balance load fluctuations, as the steam discharged from the accumulator can be automatically adjusted to the demand. It is not so well-known, that a similar effect can be obtained by indirect balance, if the fluctuations are on the high pressure (H.P.) side.

To illustrate the difference, Fig. 1 shows a typical arrangement of an accumulator in a steam plant including H.P. and L.P. consumers. Inserted are "steam charts" characterising the steady H.P. and the fluctuating L.P. demand. Without an accumulator these would add up to an irregular boiler load indicated by the dotted line. The effect of the accumulator is to turn the L.P. demand into a constant load, resulting in a total boiler load which is maintained at a steady level.

In the same simple way, Fig. 2 shows the indirect balance. Here, the peaks are caused by the H.P. consumers, and added to the steady L.P. demand would cause considerable changes in boiler output. The balance is effected in this case by a surplus regulator controlling the charging of the accumulator in such a way that the total load remains constant. When more steam is required for the H.P. consumers, less is passed to the accumulator; and vice versa, when there is a reduced H.P. demand, an increased proportion of the steam generated is passed into the accumulator. This varying rate of steam flow into the accumulator is turned into a constant flow of steam from the accumulator to the L.P. consumers, thereby obtaining a perfect indirect balance and a steady total boiler load.

Load conditions in steelworks

These are particularly suitable for the application of indirect balance, as steam hammers and presses require a relatively high steam pressure for efficient working. At the same time, their steam demand is one of the most erratic experienced in any industry. They may be standing for long periods, start operation practically without any notice, require full steam rate for a relatively short period, and then stop equally suddenly.

The steam demand graph reproduced in Fig. 3 is based on extensive tests and is characteristic for steelworks having a number of hammers as well as a large press, shown in Fig. 4. The individual steam

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*Reprints of the first article are available on application to Steam Storage Co., Ltd., 199 Bay Street, Toronto, Ont.

requirements are shown in Table I as metered during these tests:

Accumulator effect

It is not difficult to realize the difficulties created by a steam load of this character. During periods of low demand, the fire in the two boilers used at this plant had to be damped down to a fraction of their steaming capacity. Before the press started a light signal was given to the boiler fireman who increased the firing rate; but due to unavoidable delays, this caused serious steam loss through the safety valve. During press operation the boiler pressure dropped continuously, as the demand exceeded the boiler capacity. Frequently the pressure fell below the lowest pressure at which the press could work (about 120 p.s.i.), causing interruption of work and periods of waiting until the boiler pressure was recovered.

The installation of an accumulator, shown in Fig 5, which works on the principle explained under "the problem", has resulted in a balanced boiler load. During periods when the press is standing, the boiler firing can be maintained and all steam not actually required is charged into the accumulator. When press operation starts, the boilers can be quickly brought up to full steaming rate and easily supply all the steam required by the press, whilst all the steam for the hammers is supplied by the accumulator. In this way, as stated in a letter received from the clients, the accumulator "irons-out peaks most satisfactorily and allows steady firing to take place on the boilers throughout the day". It has been proved that the saving in extra labour costs alone, previously caused by waiting time (when boiler pressure was low) has paid for the accumulator during the first three years, and in addition there is a 5 per cent increase in production.

Table 1. Individual Steam Requirements

No.	*Type*	*Size*	*Pressure p.s.i.*	*Steam Demand lb./hr.*
1	Steam press	3,000 ton	160	5,500–18,000
1	Cogging hammer	15 cwt.	80	800– 1,200
1	Steam hammer	15 cwt.	80	1,500– 2,500
1	Steam hammer	50 cwt.	80	3,000– 5,000

Case 7: Supply of Dry Saturated Steam

Ideal steam

Perfectly dry saturated steam can well be called ideal, because it cannot exist in practical operation, except immediately after steam is formed over an evaporative surface. In its further flow through boiler or steam plant it is bound either to lose some of its heat content by cooling, thereby forming wet steam, or if further heated to become superheated steam.

There is no doubt that wetness is a disadvantage, and great efforts are made to ensure correct trapping which can drain the condensate formed. But superheat too can be a disadvantage under certain conditions or cause difficulties above a certain temperature.

The fact that steam discharged from an accumulator is produced direct by re-evaporation means that at the point it leaves the accumulator the steam is practically dry saturated steam.

Accumulator as de-superheater

Steam accumulators are therefore often used to transform superheated steam into saturated. This requires, of course, that all the steam is charged into and discharged from the accumulator by the so-called "series arrangement" shown in Fig. 6. The steam charged into the accumulator may have any degree of superheat; condensation is assured by correct design of the charging equipment. (It is possible to install the accumulator in the so-called "parallel arrangement" shown in Fig. 7, whereby a proportion of the steam will by-pass the accumulator, and the temperature in the L.P. main will vary correspondingly.)

It is important to note that considerable additional steam savings may result from the de-superheating

Fig. 1. Direct balance of L.P. peaks.

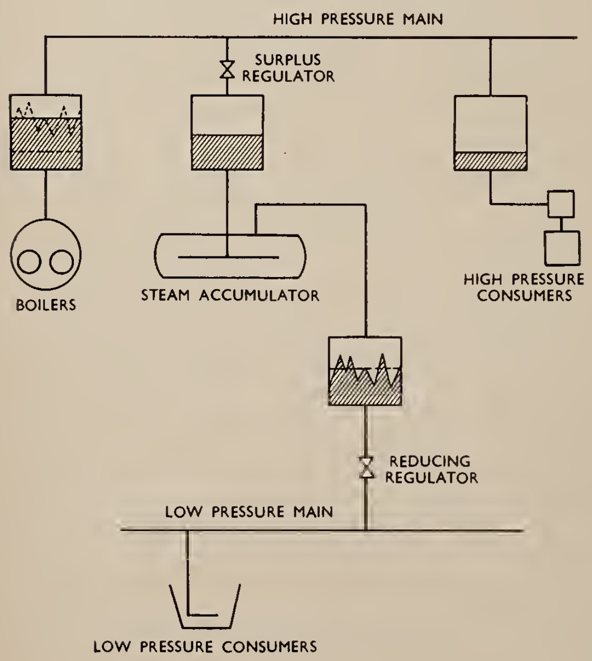
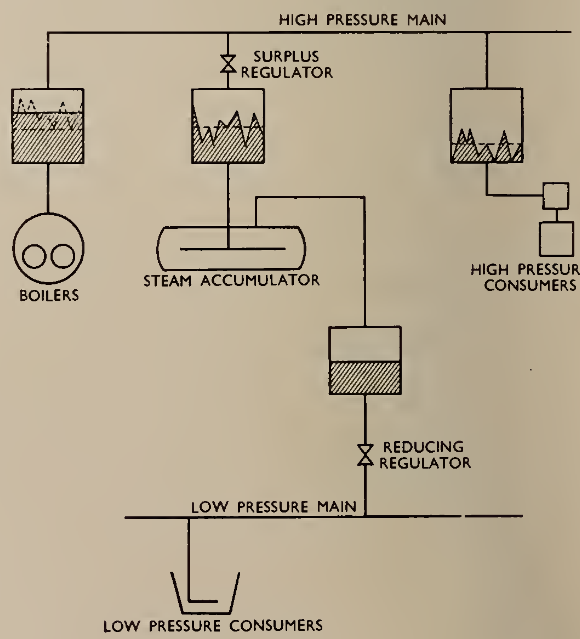


Fig. 2. Indirect balance of H.P. peaks.



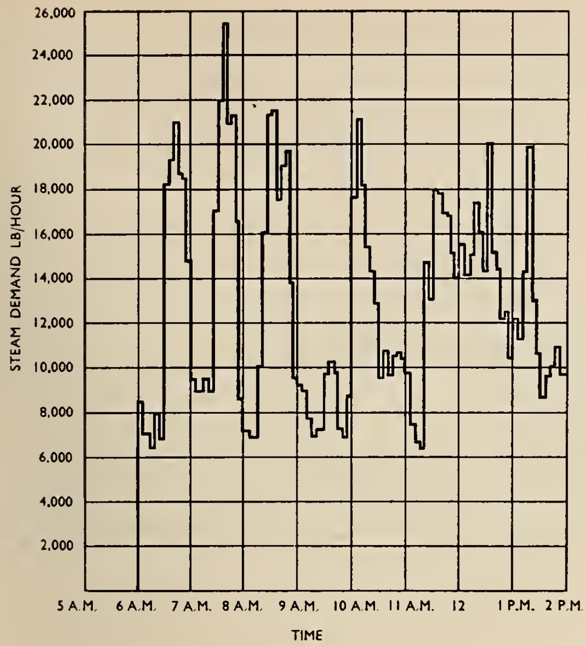


Fig. 3. Steam demand of a steel-works.

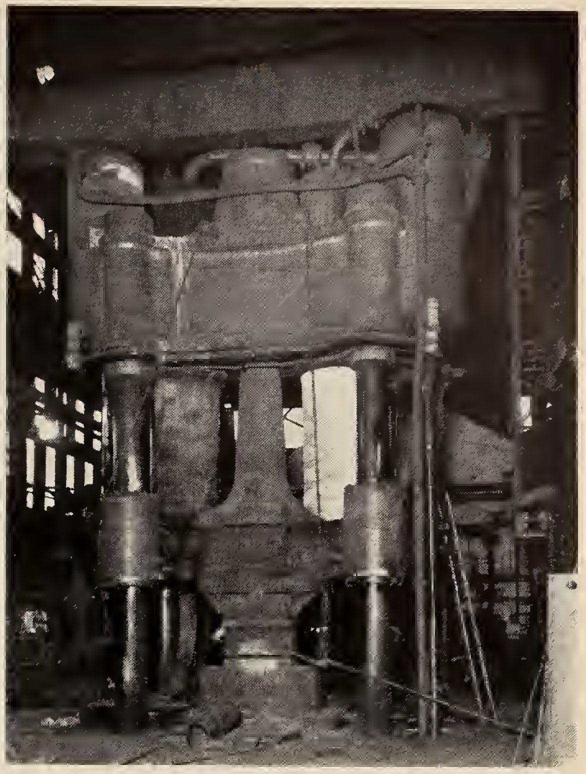


Fig. 4. Steam press in a steel-works.

effect of an accumulator. More steam can actually be discharged from the accumulator than has been charged into it. This gain, which of course is due to the lower heat content (in B.t.u. per lb. of saturated steam), can be very important. For instance, with boiler steam of 160 p.s.i. and 600° F., the theoretical quantity of steam supplied from the accumulator at an average pressure of 50 p.s.i. will be 12 per cent higher than the quantity used for charging. (In practice, however, this may be somewhat less, due to the heat lost by radiation.)

Eliminating wet steam

Wet steam may be due to various circumstances, but basically it can only be caused either by cooling losses, for instance in the pipe system, or by carry-over from the boilers. The first mentioned type can be overcome by providing steam traps; the second, however, is more difficult to cure. It depends on various factors of boiler operation, such as height of water level in the boiler, steam pressure, chemical nature of water (mainly characterized by the total dissolved solids), boiler design and the rate of evaporation. It is easy to realise that the greatest danger of carry-over exists during the period of peak demand, especially if the boiler water level has been brought up to its highest point in anticipation of such a peak, and near the time when the boiler is due for cleaning.

The amount of water carried over by steam is generally underrated, but it has a marked effect on the production side. A steam accumulator, which again must be arranged in series, can eliminate the steam wetness completely. For instance, steam of 10 per cent wetness or more may be charged into the accumulator, but the discharged steam is practically saturated, and after the reducing valve will have a slight degree of superheat.

A steam accumulator installation in a large chemical works has proved this effect; the liquid content of the vats previously increased considerably during the heating-up period. All the steam is now discharged from the accumulator and the liquid content can be maintained at a minimum. A layout of the accumulator is shown in Fig. 8, and a photograph in Fig. 9. Boiler efficiency increased from 72 to 76 per cent immediately after the accumulator was put into operation.

Case 8: Heat Storage in Boilers or Accumulators?

Storage in boilers

Before trying to decide which is the better solution of the problem—to store heat in a boiler plant which is intended for steam generation, or in an accumulator specifically provided for this purpose—it is essential to know exactly what heat storage is. Obviously, it cannot be obtained from any plant or machinery, unless more heat can be drawn from it than is produced (for instance, by combustion) at any given moment.

For a boiler to be of any use as an accumulator, one of two methods (or both) must be possible:

(*a*) a considerable pressure drop, or

(*b*) some drop in water level.

Under normal conditions this is quite impracticable, especially where pressure and/or water level are automatically controlled. In any case, it creates serious difficulties if the boiler pressure is allowed to fluctuate widely. Such conditions may lead to excessive temperatures in the economizer and undue strain on boiler tubes. Economic boilers are quite unsuitable for such working conditions (due to high gas temperatures at the back of the boiler) and steady load conditions are usually specified by the makers.

Heat accumulators, on the other hand, are designed and operated to allow the maximum change of temperature and pressure, thereby reaching the best storage effect for a given volume. As there is no combustion taking place in an accumulator, there are no high temperatures, and with no feedwater intake there are no chemical problems of corrosion or scale.

In short, no boiler plant can maintain its highest efficiency and best working conditions, and at the same time give the same heat storage effect as a separate heat accumulator. This is especially true of the more modern types where the water content is reduced to obtain greater flexibility and quicker response to changes in firing. A typical example of water tube boiler plant fitted with a steam accumulator will illustrate this point.

Water tube boilers and back-pressure engines

The plant shown schematically in Fig. 10 includes water tube boilers, working at a pressure of 300 p.s.i. and having a total output of 92,000 lb./hr. Steam is used for power generation in back-pressure engines of a total output of 1,500 kw. The back-pressure steam is used for various processes at 30 p.s.i. In view of the long distances, the L.P. steam is taken back to the boilers, and passing through superheaters obtains a temperature of 450°F.

The heat storage effect of water tube boilers is, of course, negligible, because as explained above, neither the water content (or level), nor the pressure, can be allowed to drop.

The accumulator, of 9 feet diameter x 40 feet length, works in parallel to the back-pressure engines, but its maximum pressure is limited at 150 p.s.i. In view of the discharge pressure of 30 p.s.i., it has been found that it is more economical to design the accumulator for 150 p.s.i. than 300 p.s.i., whereby the length could be reduced to 27 feet. The saving in the area of steel plates (and insulation) is more than offset by the extra thickness of the plates due to the higher pressure.

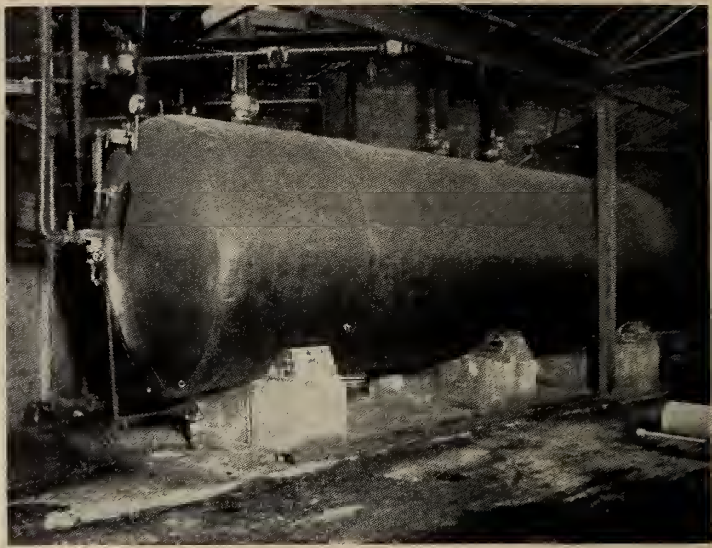


Fig. 5. The installation of this steam accumulator resulted in a balanced boiler load.

Steam requirements in breweries

The processes requiring steam in a brewery are mainly for: copper boiling; hot liquor tanks; pasteurizing; bottle washing; sterilizing. (For further interesting details see an article by S. R. Broadbent and M. V. Murray in the *Journal of The Institute of Fuel*, August 1955, page 383.) Some of these consumers are operated throughout the day at a fairly constant rate. Where the coppers are directly heated by coal or oil, conditions may not cause any special difficulties, even where water tube boilers are in operation.

There are serious peak-load problems, however, in breweries where the coppers are indirectly heated by steam coils. The coppers are usually filled with liquid of approximately 140° to 150°F. Steam is used to bring the liquids to the boiling point and then to evaporate a certain proportion; usually 10 to 15 per cent of the copper content within a period of 1½ to 2 hours. Each copper is boiled generally once per day, and as this demand is additional to all other consumers, creates a peak load as illustrated in Fig. 11. In this brewery there are a number of small coppers working to a definite plan and the demand has been calculated accordingly. In many breweries larger units are used and sometimes only one copper is boiled per day, creating a very serious peak problem for the boiler house. In many cases the period of evaporation has to be extended in an effort to reduce the peak demand (in lb./hr.), and this is, no doubt, connected with additional heat losses and operational difficulties. The best solution for the boiler house and

Fig. 6. Series arrangement of a steam accumulator.

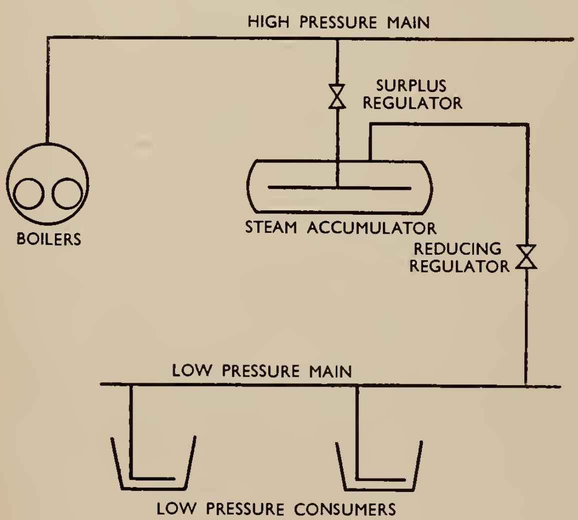
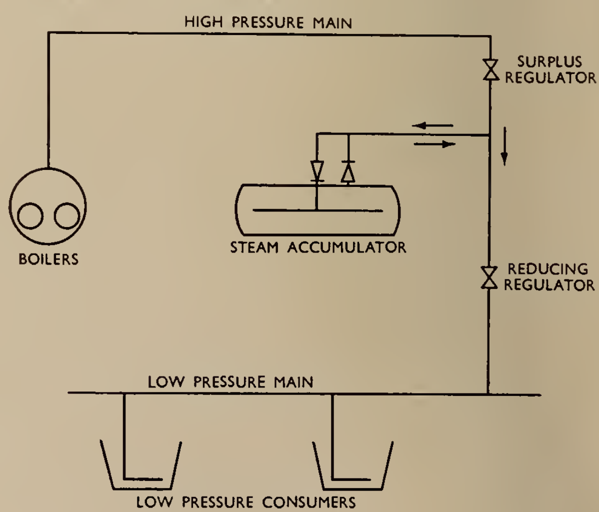


Fig. 7. Parallel arrangement of a steam accumulator.



pressure power generation, in the case of the brewery described, was found to be the installation of a steam accumulator.

Case 9: Automatic Hot-Water Storage

The purpose of automatic control

It may be necessary to start with a short explanation of what is *not* automatic hot-water storage, because there are so many failuures caused by overlooking the following facts. A tank full of hot water is not yet a hot-water accumulator. Very often such a tank is even automatically prevented from having any heat storage effect at all: there is a level switch or ball tap which keeps the tank permanently full of water. In addition, the water temperature is automatically maintained at the full values of, say, 180°F. The heat content therefore will remain constant at its full value, and the storage effect is practically nil. As soon as any peak demand for hot water occurs, it is immediately passed on to the boilers, which therefore work under most favourable conditions.

In the case of a real hot-water accumulator the automatic control is used to balance the boiler load. Steam supply is kept independent from hot-water peak demand. When consumers, for instance vats in laundries, dyeworks or leather factories, are started, the hot water is supplied from the accumulator, which is gradually emptied during the peak period. No extra steam is required from the boilers, which are thereby protected from peak-load difficulties. Steam is charged to the accumulator through a surplus valve, which opens only when the boiler pressure is high so that the accumulator is re-filled with hot water during periods of reduced hot-water demand.

Hot-water accumulator in a laundry

An example of such an accumulator, shown in Fig. 12, is interesting in respect of the power and heat balance obtained. The Lancashire boiler supplied steam at 120 p.s.i. to an 80 h.p. vertical back-pressure engine; the L.P. steam was used directly for various consumers working at 10 p.s.i. and in a heat exchanger for the generation of hot water required for various washing machines. Their demand during peak periods greatly exceeded the quantities of water which could be heated-up to the temperature required, as the amount of L.P. steam obtained from the engine was strictly limited. The effect was, of course, that the pressure could not be maintained at the full 10 p.s.i., but dropped every day to 5. p.s.i. and less.

A scheme was put forward for an automatic hot-water accumulator including a sectional cast iron tank of 14 feet x 10 feet x 8 feet deep, holding 6,000 gallons of hot-water. The automatic control consists of a surplus regulator with over-riding L.P. control; this means boiler steam can by-pass the back-pressure engine only under one (or both) of the following conditions:

(*a*) when the boiler pressure exceeds the normal 120 p.s.i.

(*b*) when the low-pressure drops below the minimum 9 p.s.i.

Under normal working conditions this valve is shut, and all the steam for process consumers comes from the exhaust of the engine at a practically steady rate. All the L.P. steam which at any moment is not required for steam consumers flows through a second surplus regulator to a heat exchanger. As this steam heats-up the water in the heat exchanger, a thermostat opens the cold water supply and maintains the flow at a predetermined rate which charges the water into the accumulator at high level.

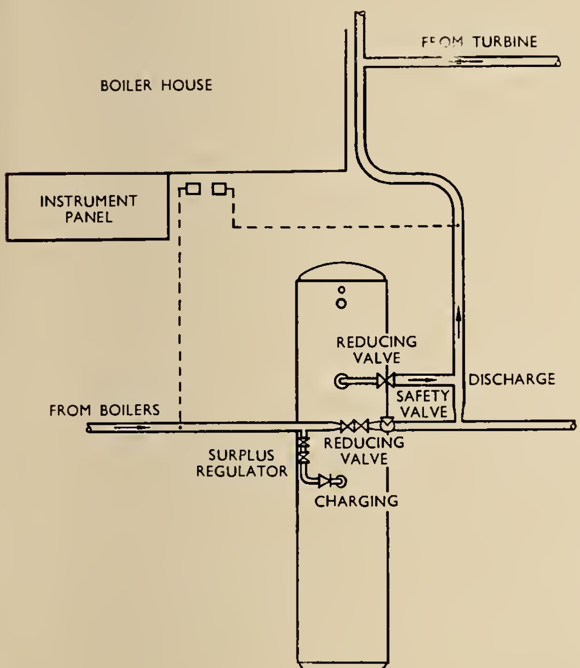


Fig. 8. General lay-out of a steam accumulator.

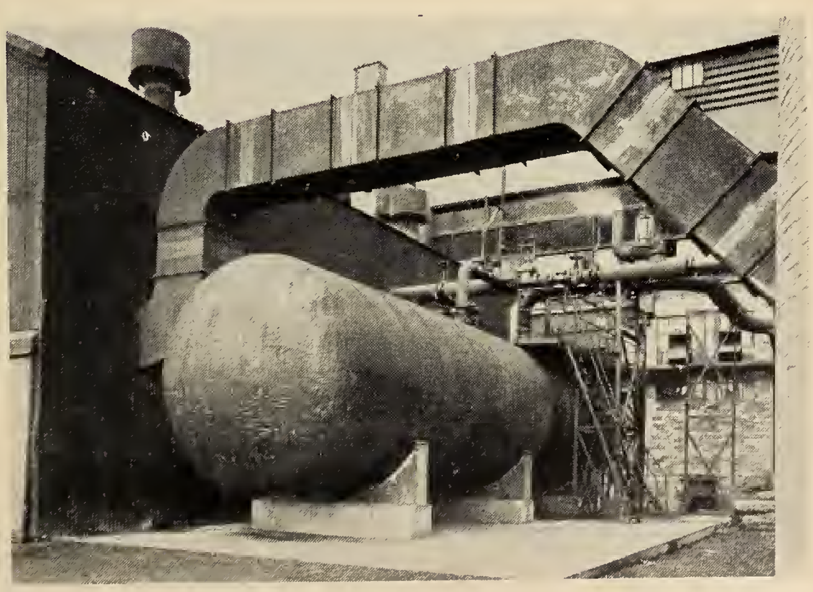


Fig. 9. A steam accumulator in a large chemical works.

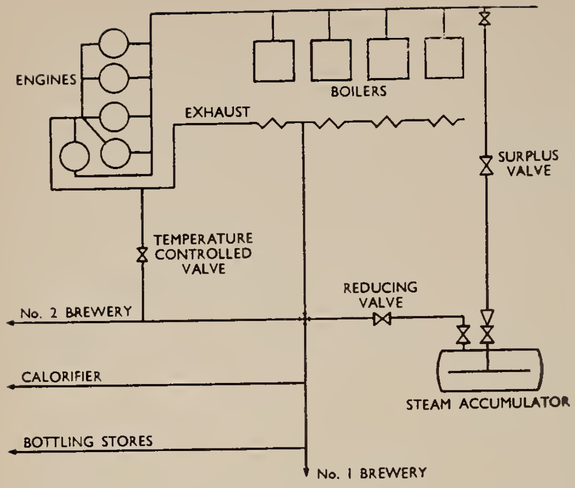


Fig. 10. A steam accumulator installation in a brewery.

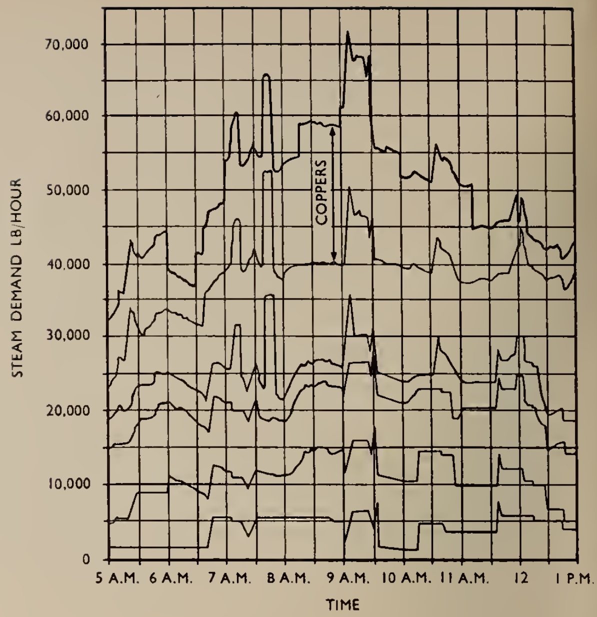


Fig. 11. Load chart of a brewery, illustrating peak load.

The accumulator is full of hot-water in the morning, and when the peak-demand starts (which exceeds the inflow of hot-water) the accumulator discharges. The results have proved the great value of the scheme: production has been increased by over 10 per cent, and at the same time coal consumption reduced by over 15 per cent.

Case 10: Electro-Heat-Storage

Peaks in power supply

Whatever the case for turning electricity into heat or steam (and no doubt it has great advantages in cleanliness, availability and automatic working, especially for the small boilers), there is a case for storing the electrically produced steam or hot-water. The main reason is, first of all, the well-known peak-load problem at the power station. Methods of overcoming this problem at the generating end, in thermal power stations, are extremely difficult and costly to accomplish, because the steam is used in the turbines at extremely high (and still increasing) pressures. Electricity itself cannot be stored, except (in chemical form) in batteries not applicable for industrial power conditions. But it has been proved that wherever electricity is used for generating heat or steam, thermal storage becomes an interesting solution on a sound economic basis. This basis is provided by the usual tariffs, which include a considerable standing charge and/or a considerable reduction in the unit rate for electricity used during the off-peak periods.

There are therefore two main applications possible:

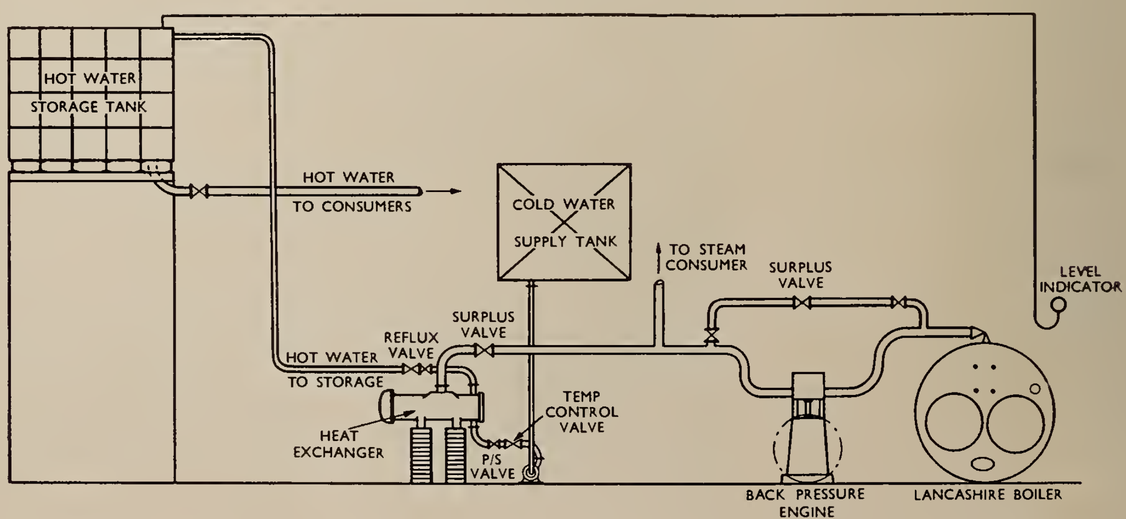
(*a*) to use accumulators which will supply steam or hot-water for peak requirements, thereby reducing the standing charge to the rate of the average kva. demand (which may be as low as 50 per cent of the peak kva. figure), or

(*b*) to charge accumulators during the night at the off-peak cheap rate and to discharge again during peak periods.

Accumulator for off-peak charging

A very interesting plant, shown in Figs. 13 and 14, includes an electrode boiler of 300 kw., working at a maximum pressure of 150 p.s.i., and an

Fig. 12. Hot water accumulator in a laundry.



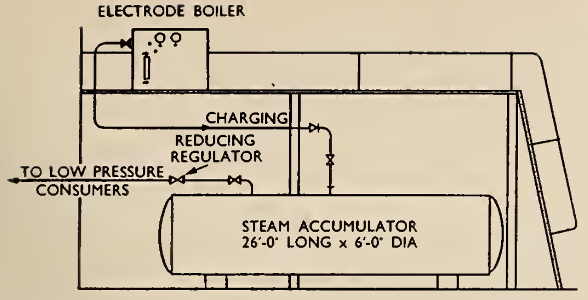


Fig. 13. An electrode boiler with accumulator for off-peak charging.

accumulator, which, discharging at 15 p.s.i., has a storage capacity of 4,500 lb. steam.

Steam is generated during the night and stored in the accumulator at a rising pressure in both boiler and accumulator. Electricity is automatically switched off during the peak periods (normally 8 a.m. to 12 noon and again 4 to 6 p.m.), when all the steam required for a large canteen and other processes is discharged from the accumulator.

The whole plant works completely automatically and has proved its operational and economic value. It constitutes a perfect illustration for smoke-free steam supply.

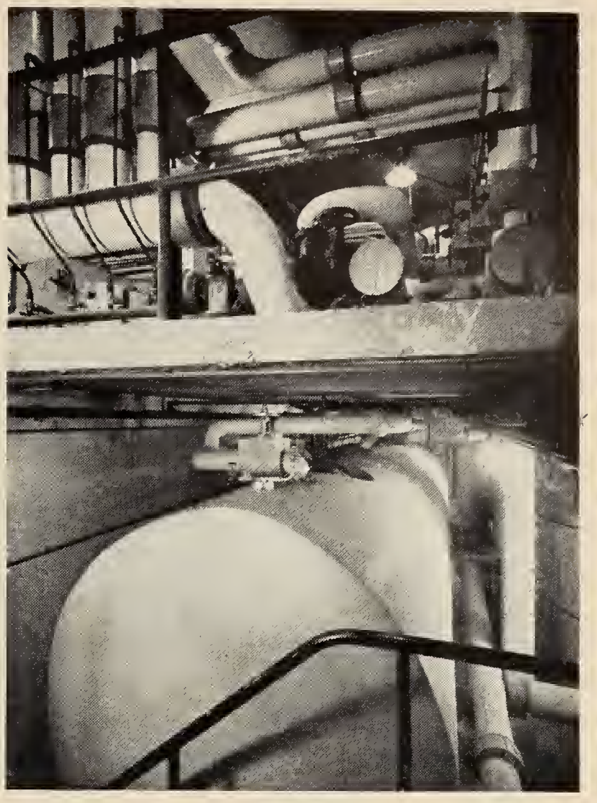


Fig. 14. A steam accumulator charged from a 300 kw. electrode boiler at off-peak periods.

The F.N. Rifle

(Continued from page 78)

the trapped sand, which under pressure of the exploded charge becomes embedded in the softer material of the cartridge case and is carried clear with extraction and ejection action. Also, under normal firing conditions, the life of the barrel when plated is increased approximately 100 per cent. As a result plated barrels have been adopted.

As the study and drawings neared completion, a small number of prototype weapons, to the new standards, were made by Canadian Arsenals Ltd., and were subjected to endurance, engineering and user trials by the Canadian Army to substantiate the design, not only of the basic weapon but of the Canadian National Preference items. These rifles were also demonstrated in U.K. and U.S.A. and the results of all trials were excellent.

Suggestions from other participating countries were introduced into the "basic design" drawings where unanimous requirement existed and when the full set of basic drawings was completed, the Armament Research and Development Establishment, in Britain, undertook a complete dimensional analysis of these drawings as a cross check.

Though it is to be expected that changes will be made in the basic drawings as the use of the rifle becomes more extensive, the final stage was reached when the basic design drawings were officially certified by the rifle steering committee for manufacture and the Small Arms Division of Canadian Arsenals went into production.

Future Annual Meetings

1958

Quebec, Chateau Frontenac, May 21, 22, 23

(See announcement on page 103 of this issue)

1959

Toronto, Royal York Hotel, June 8, 9, 10

ABSTRACTS

BASED ON CURRENT LITERATURE AND EVENTS

LITERATURE ON STANDARDS ACTIVITY IN EUROPE

"Modular Coordination in Building," a report on modular measure published by the European Productivity Agency (EPA) of the Organization for European Economic Cooperation (OEEC), is a compilation of national reports prepared by the eleven Western European countries participating in EPA project No. 174 on modular coordination. As the culmination of phase I of that project, the report summarizes the various national concepts of modular design, the current manufacturing practices in the rapidly changing building industry, and the assembly processes or methods used for building construction.

Intended as the basis for the adoption of a common module, the studies from which the report has been prepared are comparable with the 1938-45 investigation in the U.S.A. leading to the adoption of the American Standard four-inch module approved by the American Standards Association. Some recognition is given in the report to the United States experience and to the American Standards on modular measure. It is, however, a new treatment of the subject primarily reflecting the European concepts of modular design and component sizing which do not always agree with the United States approach.

The module proposed by the report for European use is one decimeter for the metric countries and four inches for the foot-inch countries. The four-inch module fortunately would coincide with the American Standard and the one decimeter module would be very nearly the same size (3.94 inches).

Adoption of a common module by the Western European countries could stimulate building construction in that area and would provide further evidence that there is European industrial integration. Since it could also affect the dimensioning of every building material product, the module selection has significance to American industry as well. Of the $245 million export of building products in 1956, nearly one quarter went to Western Europe.

The modular standardization program in the U.S.A. has, since 1938, been centred in ASA Project A62 for which the selectional committee is the standards developing group. Preliminary information to Sectional Committee A62 regarding the EPA activity and the current report have resulted in considerable interest among the American manufacturers of building materials and supplies. The ASA project is jointly sponsored by the American Institute of Architects, the Producers' Council, the National Association of Home Builders, and the Associated General Contractors of America. Under their leadership two basic American Standards on modular measure and two on specific products, clay and concrete masonry units and clay flue linings, have been developed by the sectional committee. Extensive additional work is near completion on many other building materials and products.

In view of this United States experience, the EPA group has been anxious from the inception of this project to have American cooperation in the study. While only a limited contribution was made to the present report, arrangements now are being completed for direct American participation in the remainder of the project which will be known as phase II. Cooperative participation will be effected through a contract between the EPS and the American Standards Association and will include the preparation of a report on actual United States experience with modular construction. This phase of the project will consist of national reports of this type which will then be compiled in a second international report.

A copy of the current report may be obtained from the OEEC/EPA Washington Mission, Suite 1223, 1346 Connecticut Avenue, N.W., Washington, D.C., cost $1.50.

GERMAN RESEARCH AND INDUSTRIAL NOTES

The special program of the German Research Council *(Deutsche Forschungsgemeinschaft)* is discussed in the September 1957 issue of *Hochschul-Dienst*. The Council is the central research organization in the German Federal Republic; it furthers the collaboration of scientists, advises public authorities on scientific matters, and provides financial assistance for specific research projects. The *Notgemeinschaft* (Emergency Association for German Scientific Research), founded in 1920, was dissolved in 1945. The present Council was established by various groups in 1949 to support basic research, applied research being left to individual interested parties to finance. The German Federal Government and Parliament then granted DM 5 million in 1952, to be devoted to research in which Germany had to catch up with other countries. Grants were increased in following years and are now DM 15 million a year.

Among the first fields covered by a special project program were virus research, microbiology, nuclear physics, and aviation research. Later, shipbuilding research, finishing techniques, technical thermodynamics, and research into macro-molecular substances were added. Institutions with large electronic computers were established to accelerate calculations and solve many problems. The liberal arts were included in the second year of the program.

Existing programs have been extended to include such fields as radiology, cell research, botanic photobiology, genetics and behaviour research, analytical chemistry and photo-chemistry, acoustics, solid substances and metallurgical physics, and radio astronomy. German participation in the International Geophysical Year was supported. Further projects included gearing and propulsion, construction engineering, water economics, land cultivation, and agricultural and forestry problems, among many others.

Radiation Hazards — W. Theimer, in *Deutsche Korrespondenz* (14 Jan. 1958) discusses the danger of radioactive fallout of strontium 90 (Sr 90), considered one of the most dangerous elements, which can produce cancer of the bone and other serious diseases. Absorption is a long process via the soil to plant and animal foods, but it is cumulative. Some scientists estimate that fallout from nuclear tests already carried out will cause dangerous concentrations after about fifteen years. Further tests will increase the danger.

Professor E. H. Graul, of the Institute of Radiation Biology, Marburg University, has recently surveyed all the factors involved. Children are particularly susceptible, having a higher absorption potential than adults, and growth of bones may be affected in addition to the other effects. Studies in America, Britain, and India have not given a unified picture, but the present standard for maximum permissible concentration (MPC) is one-thousandth of a microcurie of Sr 90 per gram of body calcium. In 1955 the concentration of Sr 90 in the human body was only one ten-thousandth of the MPC, but by 1970 the continuing fallout will raise this by a factor of ten. If no further major nuclear tests are made in the interval, equilibrium will then be reached between intake and radioactive decay. Sr 90 has a half-life of 28 years.

According to Prof. Graul, contamination by Sr 90 in Western Germany is only two-thirds of the world average. However, concentration in the age group 0 to 4 reaches ten times that in the group 40 to 50, and although the *average* contamination will have reached only one-thousandth of the MPC, even in ten years, owing to statistical distribution some people will have absorbed ten times that concentration. This is still only one per cent of MPC, but many experts believe that the MPC has been fixed at too high a level and should be reduced to a tenth of its present value, so that average people will carry one per cent of the real MPC, while the statistically most unfortunate will have accumulated as much as 20 per cent of MPC in their bones.

This would still be far below the critical limit, but would ominously reduce the margin of safety for further nuclear weapon tests. As for children, Prof. Graul feels that their MPC should be assessed at one-third to one-tenth of that for adults, and it is likely that certain of the children who will be 10 to 15 about 1970 may have a concentration of Sr 90 of the order of the critical limit.

PREFABRICATION FOR £1,000,000 TEXTILE MILL IN NIGERIA

An interior view of a £1,000,000 textile mill opened in November 1957 at Kaduna, Northern Nigeria. The plant will have a capacity of about 12 million yards a year of cloth from locally-grown cotton. The factory covers an area of 140,000 sq. ft. and the superstructure is a steel-framed multi-span sawtooth roof, supplied by Taylor Woodrow (Building Exports) Ltd., who market for the Arcon group of prefabricated building manufacturers. It is 650 ft. long and 225 ft. wide, and is one of the largest prefabricated buildings to be shipped from one country to another. Components, including over 330 tons of steelwork, 170 tons of glass and glazing bars, and 75 tons of aluminum, were manufactured, assembled, and shipped within eight weeks of receipt of the order. From Lagos, components made a rail and road journey of 560 miles to the site, where excavation of 53,000 cu. yd. of soil was necessary. The mill is clad in concrete blocks, some 90,000 of which were made on site. A total of 1400 tons of cement were used, and 4000 tons of stone from a local quarry were crushed on site. David Whitehead and Sons Ltd., managing agents for the mill, installed steam and textile machinery, including 14,000 spindles and 300 automatic looms. The air-conditioned mill will employ about 700, on three shifts, at full production.

RECENT LOANS MADE BY THE WORLD BANK

Among many loans made by the International Bank for Reconstruction and Development (known as the World Bank), five widely diversified countries have been assisted in recent months—India, the Philippines, the Belgian Congo, Pakistan, and Mexico.

India — The privately-owned Tata Iron and Steel Company Limited, the largest in India, received $32,500,000 towards completion of an expansion program aimed at doubling the company's steel ingot producing capacity to two million tons a year (1.1 million in 1950); finished and semi-finished steel output will be raised to 1.5 million tons. Main installations to be completed are a battery of coke ovens, an ore crushing and sintering plant, a blast furnace, increased converter and open hearth capacity, a blooming mill, continuous sheet-bar and billet mill, and a structural mill. All major works, under supervision of Henry J. Kaiser Co. engineers, are expected to be completed by June 1958, the remainder within two years thereafter. This is part of a program to bring domestic steel production abreast of demand by March 1961. Another large contribution will come from the privately-owned Indian Iron and Steel Company, also with World Bank support.

The Philippines — The first loan to the Philippines, equivalent to $21 million, will assist the National Power Corporation to build the Binga hydro-electric project in the island of Luzon. There will be a dam and reservoir on the Agno River in northern Luzon, an underground powerhouse with an installed capacity of 100,000 kw., and transmission lines to Manila, about 120 miles to the south, and to various provincial areas. Work has begun and is expected to be completed in 1960. Of a potential of at least 600,000 kw. in Luzon, only about one-sixth has been exploited. Binga is the second of six projects planned to exploit the potential of the Agno and Toboy Rivers.

Belgian Congo — A loan equivalent to $40 million was made towards road construction and improvement, forming part of the ten-year plan for the development of the Belgian Congo. The project involves the construction of 750 miles of new highways, the improvement of 560 miles of existing roads, and preparation for mechanized maintenance of a further 2060 miles. Improved road transport is urgently needed to encourage the change from subsistence agriculture to cash-crop cultivation, to open up tracts of unused land, and to allow for further growth of industrial employment. The Congo has become the world's largest supplier of cobalt and industrial diamonds, a major exporter of copper and other minerals, and an important source of vegetable oils and other agricultural commodities.

Pakistan — The Pakistan Industrial Credit and Investment Corporation, formed by Pakistani, British, American, and Japanese investors, has received $4.2 million to assist in the expansion or modernization of small and medium sized industries and to help create new ones. Esgo T. Kuiper, of the Netherlands, who organized and was first managing director of the Indonesian Industrial Bank, is general manager of the Corporation.

Mexico — The privately-owned Mexican Light and Power Company (Mexlight) has received the equivalent of $11 million for the expansion of the Company's electric power system. Transmission and distribution systems are being extended, and generating capacity expanded by some 95,000 kw., or about one-fifth. The 12,000 sq. mile area served by Mexlight is the chief governmental, industrial, and commercial centre of Mexico. Expansion now being undertaken includes the addition of an 82,400 kw. unit to the 66,000 kw. Lecheria thermal plant, modification of two generating units in the Nonoalco thermal plant to increase capacity by 12,500 kw., and extension of transmission and distribution networks. Completion of work at Lecheria is scheduled for April 1958.

ENGINEERING NEWS FROM THE U.S.S.R.

Soviet News Bulletin, 17, 22, and 29 Jan. 1958; *UNESCO Features*, Oct. 1957

Inter-Planetary Flight — A recent article by Y. Khlebtsevitch discusses the idea of sending a manned expedition to the moon. To make a round trip, returning to earth a manned unit weighing 10 tons would require an eight-stage rocket weighing initially nearly 4,000,000 tons, according to the rocket-flight equation developed by the Russian scientist K. Tsiolkovsky. Apart from the unknown factors engineering problems are insuperable. The only solution seen at present is the use of intermediate stations in outer space.

Discussing the proposal of Dr. Wernher von Braun (designer of the rocket that recently launched the first successful United States earth satellite) to build a 260-foot dia. circular satellite (Flying Isle), that would revolve round the earth at an altitude of 1075 miles, the author states that the project has many weak points. About a thousand 6400-ton rockets would be needed to convey the satellite parts to their orbit before assembly, after which a further 1500 similar rockets would take men and equipment for assembling the space ship that would proceed to the moon. The expenditure of fuel alone would be several dozen million tons. The alternative use of nuclear fuels is not foreseen as practicable before the end of the century. The Russian approach is to concentrate on one-way trips to the moon (or Mars) with much smaller unmanned rockets containing recording instruments including television cameras.

Another Viewpoint

Another point of view was expressed by Prof. G. Chebotarev, of the Soviet Academy of Sciences, in an interview reported by *UNESCO Features*, October 1957. This proposes a trip from earth to moon and back by a rocket which would not use fuel for most of the time, but would be motivated by gravitational forces. A three-stage 16.8-ton rocket would follow an elliptical course reaching a point 18,000 miles beyond the moon. The speed to escape from the earth's gravitational pull would be about eight miles a second. The influence of the sun's attraction was calculated to be negligible.

Solar Energy

Solar Electric Station — Small solar-heat units have been in use for some time in the southern districts of the U.S.S.R. Prof. V. Khashchinsky describes the first experimental industrial helio-electric station, being built in the Ararat valley, near Yerevan, the capital of Armenia. Average annual sunshine is 2600 hours — about seven hours a day. The site is circular, over half a mile in diameter, with a projected 130-foot tower in the centre, equipped with a large revolving boiler. Surrounding the tower will be 23 concentric railway lines, on which 23 trains will carry 1293 large reflecting mirrors. These mirrors will automatically follow the sun and the boiler will rotate to present its radiation-absorbing "screen" continually to the reflected rays. A model is already undergoing tests.

The planned electrical capacity from the steam generated in the boiler is 1200 kw., and power will be supplied to neighbouring communities and to irrigation pumps. When there is no sunshine, the existing electrical supply will be brought in to serve the consumers. Underground heat accumulators will also store solar-heated water at about 80°C. Research into the direct conversion of solar energy into electric energy includes a thermo-electric generator designed in the Institute of Energetics of the U.S.S.R. This uses bi-metallic elements for the conversion, but photo-elements and semi-conductors are also being investigated.

Welding

High-Frequency Welding — A high-frequency current generator has been developed to supply welding equipment with which pipe up to about 2.4 in. diameter can be welded continuously from sheet metal at a speed of 325 feet a minute.

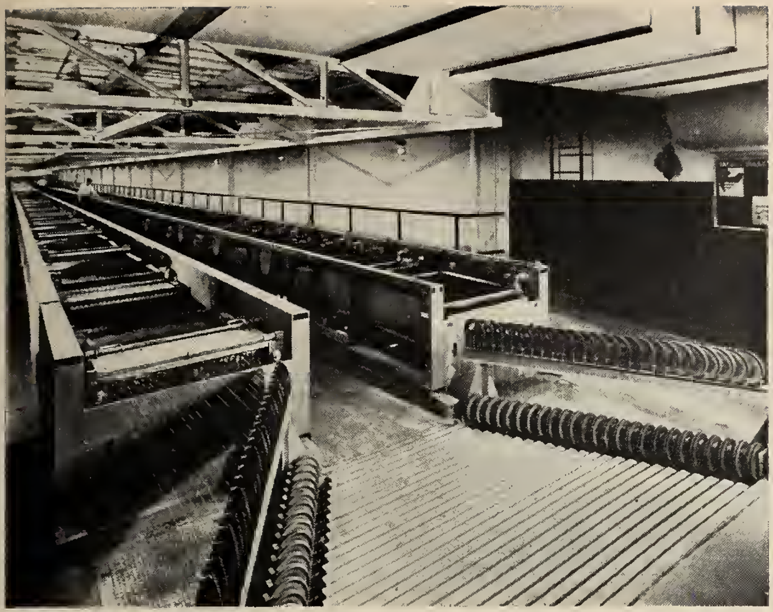


Fig. 1. One of the two 600-ft. long units for heavy copper-plating of wire. The 25 channels of wire are cleaned and partly plated in the tanks at left and then travel back the length of the building for completion of coating.

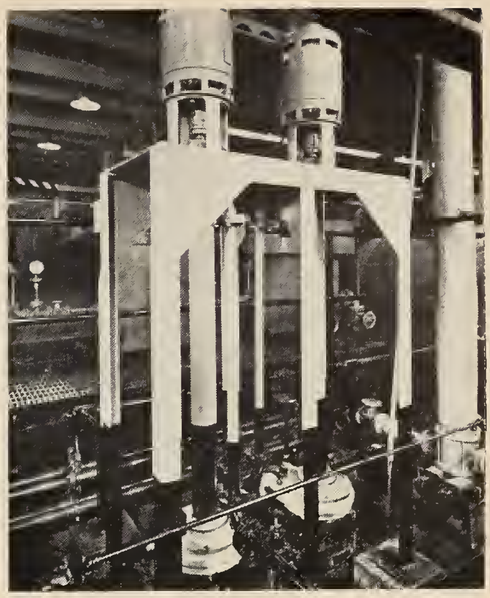


Fig. 2. Heavy duty vertical sump pumps handle the corrosive electrolytes. These are mounted above the storage tanks, others are submerged.

CAST STAINLESS PUMPS FOR CORROSIVE ELECTROLYTES

Alloy Casting Institute, Mineola, N.Y.

Continuous heavy copper plating of steel wire, at the Point Breeze Works of the Western Electric Company, Baltimore, Md., has posed serious problems of handling extremely corrosive electrolytes, which have been partly solved by the extensive use of cast stainless steel pumps.

Housed in a special building, the 600-foot long tanks for producing telephone drop wire are shown in Fig. 1. One electrolyte solution of copper fluoborate contains about five ounces per gallon of fluoboric acid and 20 ounces of copper, has a pH of less than 1, and is used in the temperature range 120° to 135°F. Other corrosive solutions are involved in the process, and extensive use is made of corrosion-resistant materials in tanks, mixing devices, piping, and so on. To handle the solutions, Western Electric standardized on heavy-duty vertical sump pumps (Fig. 2) supplied by the Aurora Pump Division of the New York Air Brake Company, Aurora, Ill.

All metallic pump components below the base plate are of cast stainless alloy, except for studs and nuts, which are made of a corresponding grade of wrought stainless steel. Most of the parts such as the impeller and its housing are statically cast; but the supporting and discharge pipes are centrifugally cast. The cast stainless alloys chosen for all parts in contact with the solution were (Alloy Casting Institute designations): type CN-7M, which contains about 29% nickel, 20% chromium, 2% molybdenum, 3% copper, with 0.07% max. carbon; type CF-8M alloy, which has about 20% chromium, 11% nickel, 2.5% molybdenum, with 0.08% max. carbon. To avoid intergranular corrosion the castings are given a solution heat treatment — heating to between 1950° and 2100°F., followed by water quenching.

To make the completed conductor, the wire receives 32 separate treatments in nine different chemical solutions, six of which require the use of cast stainless pumps. An alkali cleaner removes oil and other impurities; a sulphuric acid pickle removes scale, rust, and other mechanical particles and imparts a slight etch. Both of these use the stainless sump pumps. A thin flash of copper is deposited from copper cyanide solutions, which do not require special pumps, and the wire then enters the production plating section, in which there are 58 plating cells alternating with 57 copper contact rolls to prevent overheating of the wire and to ensure close control of the copper deposit. Four out of six CN-7M alloy pumps continuously circulate the copper fluoborate solution from storage tanks to plating cells. Pumps are submerged in the storage tanks, and each delivers 800 g.p.m. at 60 ft. head. Four of six type CF-8M alloy pumps circulate the solution during continuous filtering and intermittent solution handling. These pumps are mounted outside the storage tanks (as in Fig. 2) and deliver 50 g.p.m. at 125 ft. head.

The wire is finished by passing through a hydrofluosilicic acid bath to remove oxide formed during an intermediate annealing treatment, followed by lead plating from lead fluosilicate (both solutions requiring CN-7M pumps), and a final brass coating from a cyanide solution, which does not need special pumps.

THERMONUCLEAR RESEARCH IN SWEDEN

The Swedish — International Press Bureau, 29 Jan. 1958

For two years at Upsala University Professors Per Ohlin and Kai Siegbahn have experimented with thermonuclear reactions, in close collaboration with the ASEA company and with the Swedish State Power Board. Apparatus similar to the British Zeta (see "International News, p. 90), but smaller, has been built. A much bigger unit, due to be completed this spring, will be able to store considerably more energy than Zeta, but will have a smaller discharge tube. It is expected that results, in terms of length of fusion (i.e., thousandths of a second) will be comparable with British work.

INTERNATIONAL NEWS

Fusion and Fission in the United Kingdom

THE OUTSTANDING ADVANCE in recent times in the field of nuclear energy was announced to the public on 24 January 1958. Compared with some of the ensuing effusions in the press, the official announcement by the United Kingdom Atomic Energy Authority was modestly phrased.

"Research at Harwell [the UKAEA research centre in Berkshire] with the latest apparatus has led British scientists to the conclusion that control of thermonuclear reactions for electricity generation may well be a possibility for the future, though its practical application is still a long way off. . .

"Results obtained with the Harwell apparatus Zeta suggest that 'thermonuclear neutrons' have been obtained, but further experiments will be necessary before this can be proved conclusively. Temperatures reached in this apparatus have been as high as five million degrees Centigrade, higher than the measured surface temperatures of any star."

The announcement continues with further details of the apparatus and the results obtained. (See also ref. [5])

Zeta

The apparatus known as Zeta was designed and built by the U.K. Atomic Energy Authority with the collaboration of the Metropolitan-Vickers Electrical Company, Limited. A discharge chamber consists of a ring-shaped tube or torus of one metre bore and three metres mean diameter, containing deuterium gas at low pressure. (Deuterium, known as "heavy hydrogen", is an isotope with twice the atomic weight of "ordinary" hydrogen.) The tube is encircled over part of its length by the iron core of a large pulse transformer. A current pulse is passed into the primary winding of the transformer from a bank of capacitors capable of storing 500,000 joules of energy. The pulse induces a large unidirectional pulse of current in the gas; peak currents up to 200,000 amp. have been passed through the ionized gas for periods up to 5 milliseconds. (Longer times, perhaps several seconds, will be required for useful power output; these times, with higher temperatures, are foreseen to be eventually possible.)

The pulse, or discharge, heats the gas and also produces a strong magnetic field which causes the particles to be pulled to the centre of the tube and away from the walls, also raising the temperature further. The effect is known as a pinched toroidal gas discharge. In early experiments it was found that the discharge was unstable and tended to "wriggle", eventually coming in contact with the walls of the tube, causing serious heat losses and vaporizing the walls. An additional magnetic field helps to prevent the wriggling.

The operation of Zeta is illustrated on page 91.

Zeta was started up on 12 August, 1957, and nuclear reactions were produced on 30 August. Neutrons produced during the experiments were observed and, although their source was not claimed to be definitely established, there were good reasons to think that they came from thermonuclear reactions such as the fusion of two deuterium atoms to produce helium, neutrons, and energy.

(This fusion of light atoms — at very high temperatures to produce nuclear velocities sufficient to overcome the Coulomb barrier, or repulsive force of the particles' like electric fields — is the reaction which produces the high thermal energy of the sun and similar stars.)

There is not space here to discuss details of the work and the results obtained, but various papers on the subject have been published. [1,2,3]

Control desk of the thermonuclear apparatus Zeta (Zero Energy Thermonuclear Assembly). Oscillographic measurements are being made on the gas discharge.

Sceptre III

Work on thermonuclear research was first started by independent groups, one at the Clarendon Laboratory, Oxford, which moved in 1951 to Harwell; the other, under Sir George Thomson, at Imperial College, University of London, transferred in 1951 to Associated Electrical Industries (A.E.I.) research laboratory at Aldermaston, some 20 miles from Harwell. The two groups have collaborated closely, and following the satisfactory results obtained at Harwell a similar discharge was produced and high temperatures reached in the A.E.I. apparatus, called Sceptre III.

Sceptre III is smaller than Zeta, with an aluminum toroidal tube of 12-inch tube-diameter and 45-inch mean torus diameter, threaded with an iron core weighing four tons. Energies up to 40,000 joules have been discharged into the apparatus (cf. 200,000 joules in Zeta); currents up to 200,000 amp. have been generated and temperatures of nearly four million deg. C. have been measured.

Research in thermonuclear physics

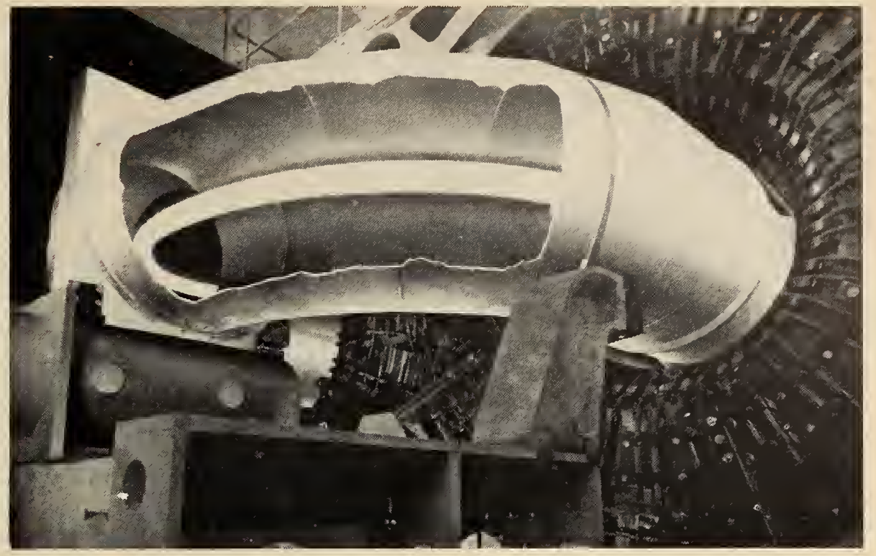
is also pursued in the United States, the U.S.S.R.[4], France, Germany, and Sweden. (A note on Swedish work is on page 89 of this issue.)

Personalities

Head of the General Physics Division, and Chief Physicist, Atomic Energy Research Establishment, Harwell, is D. W. Fry; leading the group responsible for Zeta is Dr. P. C. Thonemann, an Australian, who worked on the early stages of the program, at the Clarendon Laboratory, Oxford. Other senior members of the group are: R. Carruthers, concerned with design and prototype experiments; R. S. Pease, leader of the Zeta team; J. T. D. Mitchell, assistant chief engineer at Harwell; and Dr. W. B. Thompson, honours graduate of the University of British Columbia.

Sir George Thomson, who started experimental work on controlled thermonuclear reactions at Imperial College in 1947, and who continues to advise the group at the A.E.I. Research Laboratory, was awarded the Nobel Prize for Physics in 1937 and is a Royal Medallist of the Royal Society, among many other distinctions in the field. Dr. T. E. Allibone is director of the Laboratory, and senior members of the Aldermaston group are D. R. Chick and Dr. A. A. Ware.

Full collaboration in the field of thermonuclear research was established with the United States Atomic Energy Commission in October 1956.



A cut-away view of the Zeta torus, showing the transformer on the right. The white strip in the centre of the torus indicates the pinched gas discharge.

NUCLEAR POWER PROJECTS

Contracts for the world's first three nuclear power stations designed exclusively for power generation were announced in London on 13 December 1957. Negotiations for a fourth have been started. Net output of the three stations will be nearly 900 megawatts.

The largest will be built in the south of Scotland by the General Electric Company — Simon Carves group, with installed capacity up to 360 Mw. and guaranteed output of 320 Mw. Coal saving will be at least a million tons a year, and expected use before shut-down is at least 20 years. The station will cost about £35-million plus £2-million for initial research; cost of electricity delivered (in 1961) will be 0.7 pence per unit.

The second and third units will be at Bradwell, Essex (Nuclear Power Plant Company), and at Berkeley, Glos. (A.E.I.—John Thompson group), with respective net outputs of 300 Mw. and 274 Mw.

In addition, the Central Electricity Authority is negotiating with the English Electric, Babcock and Wilcox, and the Taylor Woodrow group for a fourth station in Somerset, in the west of England. The stations will be improved versions of the gas-cooled graphite-moderated type used at Calder Hall.

Capital investment for the four stations will be more than £150-million. Cost of the first three new stations will not be less than two and a half to three times that of conventional stations, but it is hoped that the cost of further units will be progressively reduced until nuclear power will become competitive with or even cheaper than that produced from coal and oil.

New Nuclear Power Group

A further British group was formed in December 1957 to tender for design and supply of nuclear power stations in the U.K. and abroad. The companies involved are: Richardson's Westgarth and Co. Ltd., suppliers of generating plant; International Combustion (Holdings) Ltd., steam generating equipment, including reactor, heat exchangers, and pressure vessels; and Crompton Parkinson Ltd., switchgear, transformers, cables, and motors The group will operate through a joint company — Atomic Constructions Ltd. — with authorized capital of £1-million.

OTHER NUCLEAR DEVELOPMENTS

Recent developments in Britain include expansion of the Radio-chemical Centre, at Amersham, Bucks., where radio-isotopes are processed and some 18,000 consignments a year are distributed in Britain and fifty different countries; a new research establishment (reactor design and development) at Winfrith Heath; and the Rutherford High-energy Laboratory, at Harwell.

A £1-million contract for the latter, to be directed by Dr. T. G. Pickavance, has been awarded by the National Institute for Research in Nuclear Science for buildings that will house the Institute's new large accelerator (proton synchrotron). The magnet of the synchroton will be in a concrete building with a roof 4 ft. 6 in. thick plus a covering of 10 ft. of earth and provision for a further 10 ft. of earth if necessary. The main shielding wall will be 28 ft. of concrete, with movable blocks up to a height of 12 feet. The magnet yoke will consist of 340 steel blocks, each weighing 20 tons, and will cost over £1,250,000.

Expenditure on Nuclear Energy

Gross expenditure on atomic energy authorized by Parliament, for five years to 31 March 1958, totalled about £340-million, excluding sums not disclosed for security reasons, and expenditures on their own account by industry and universities.

References

1. Post, R.F.; **Rev. Mod. Phys.**, 1958, July.
2. Thonemann, P.C.; **Nuclear Power**, 1956, May.
3. Ware, A.A.; **Egineering**, 1957, Nov. 15.
4. Academician Kurchatov; **Engineering**, 1956, v. 181. p. 322, (Paper read at Harwell on Soviet work on pinched gas discharges.)
5. **Engineering**, 1958, v. 185, no. 4795, 31 Jan.

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

Nuclear Power Plant Division for A.E.C.L.

As announced February 1, 1958, by the Hon. Gordon S. Churchill, Atomic Energy of Canada Limited will set up a Nuclear Power Plant Division which will be responsible for directing and co-ordinating the Nuclear Power Demonstration (NPD) project and the development program for a 200,000 kilowatt nuclear power plant. The division will be located in Toronto. The Hydro Electric Power Commission of Ontario will provide the office accommodation.

The H.E.P.C. of Ontario has also agreed to make available the services of H. A. Smith, Hydro's assistant general manager (engineering), as manager of the new division. Mr. Smith has been on loan to A.E.C.L. for the past four years, during which time he was in charge of the Nuclear Power Branch at Chalk River. This branch prepared the outline specifications for the NPD reactor and also carried out the preliminary design study for the nuclear power plant.

John S. Foster has been appointed deputy manager of the new division. Mr. Foster's services were loaned to A.E.C.L. by the Montreal Engineering Company Limited early in 1954. He was associated with Mr. Smith in the work of the Nuclear Power Branch in 1954 and 1955. During the past two years Mr. Foster has been on loan to the Canadian General Electric Company in connection with the detailed design of the NPD reactor.

Several utilities in addition to the H.E.P.C. of Ontario and several manufacturers have already indicated a desire to provide staff to the new division. A.E.C.L. would welcome enquiries from the other utilities and from all the manufacturers which are now engaged in the program or which may have an interest in the program.

The development program for the 200,000-kilowatt nuclear power station will require a period of from 3½ to 4 years for its execution. The object of the program will be to demonstrate the engineering feasibility of the design concepts and to prepare a cost estimate for a station of this design. The major part of the development work will be undertaken by Canadian manufacturers. That part of the program requiring the use of reactor facilities—reactor core design and the design and development of fuel elements—will be carried out at Chalk River. The NRX reactor proved to be a unique tool in this type of applied research and development. The NRU reactor which came into operation on November 3, 1957, will make available even better facilities for research and test.

Design of the NPD reactor and the conceptual design for the nuclear power plant are based on technology which Canada has pioneered with the NRX reactor—that is the use of natural uranium as a fuel and heavy water as a moderator. This technology offers excellent promise of producing power at a cost which will be acceptable in some parts of Canada. In the early years of power reactor development, Canada was alone in applying this particular technology. It is significant that a number of other countries are now showing considerable interest in the natural uranium-heavy-water system. It is said to be well adapted to European requirements.

The successful development of a nuclear power station using natural uranium as a fuel will help to provide a larger, more diversified market for natural uranium produced in Canada.

Sturgeon Lake Power Plant

Canadian Utilities, Limited, Edmonton, started full production at the $1 million generating plant at Sturgeon Lake, a gas turbine powered unit.

The full load test, January 21st. was made under the supervision of engineers of Brown Boveri Canada, Ltd. The test established a new engineering record in that this was the first time this particular type and size of gas turbine generator has ever produced 10,000 k.w., it is reported.

Regular production was to be interrupted February 1st for a routine three-day inspection of bearings and other critical factors.

The new plant will serve the entire Canadian Utilities, Limited, Grande Prairie area and the Slave Lake group of communities. In addition, power will be supplied to the Northland Utilities, Limited system in the High Prairie area. The inter-company exchange will be made through an interconnection located between the Sturgeon plant and Joussard. A total 395 miles of C.U.L. transmission line, in the north-west, will be served from the Sturgeon plant.

The Grande Prairie diesel powered generating plant with a capacity of 6,000 k.w. will serve as a stand-by unit for emergencies, following completion of the February inspection at Sturgeon.

Located 12 miles from Valleyview the new plant has the first gas turbine to burn flare gas direct from an oilfield and particularly in the generation of electricity. Construction was commenced in September, 1956.

St. Lawrence Seaway and Power Project

With first half of January comparatively mild, weather was generally favourable for work on the seaway. With dredging and some excavation closed down for winter, overall employment had fallen to around 9,000 or about 43 per cent of the peak employment last fall.

Progress By Ontario Hydro

Employment for the month averaged 3,100. Work, exclusive of equipment and machinery installation on Canadian half of the international power-house, had reached some 83 per cent of completion, while placing of concrete was 90 per cent completed and was continuing, with 895,000 yards poured to month end.

All the trash racks were in place on the intake structure and the majority of the intake gates were delivered. Drum gates were being installed on the ice sluice. The intake gantry was in operation and the power-house gantry was operating on part load. Two turbines were installed. Assembly of the first four generators was under way, with one stator aligned and levelled, and two more stators nearly completed. Assembly of two rotors was 90 per cent complete.

All dikes on the Canadian side were completed. Excavation at Iroquois Point was 66 per cent finished, with only dredging to complete. Channel improvement at Chimney Island had been 70 per cent completed. At Galops Island there was some work left on dredging, and on cofferdam removal on the first stage. At Point-three-Points, with 75 per cent of channel improvement completed, work was being continued, while near Morrisburg and at Cardinal channel improvement had reached 10 and 25 per cent respectively. Dredging at all these points was adequate for 14-foot navigation.

Clearing of bushland and trees on the Canadian side was 80 per cent completed, and demolition of houses was proceeding. A start will be made in April on the removal of the first four cells of the downstream power-house cofferdam. Drilling of the earth cofferdam upstream was under way in preparation for its removal in the spring by blasting. Town services at both Ingleside and Long Sault had been turned over to the respective municipalities. The Morrisburg pumping station was put on line. Churches had been opened for use or were nearing completion, while public school construction was progressing.

Progress by NYSPA

Employment during January averaged 1,950 persons. 1.9 million yards of concrete had been placed on all structures and 49.4 million yards of excavation or 94 per cent had been moved. On the American half of the international power-house, work exclusive of equipment installation was 82 per cent completed. Ninety per cent of the concrete had been placed, with placing continuing on a five day schedule. The ice-sluice drum gates were being installed and work of installing the trash racks had commenced. None of the intake gates had been delivered.

Three turbines had been installed at month-end, with a fourth being assembled on the erection bay. Two generators were being assembled. The 300-ton gantry crane was in operation. Installation of electrical equipment had reached about 20 per cent of completion. The switchyard was 40 per cent completed, with structural steel being erected and transformers being installed.

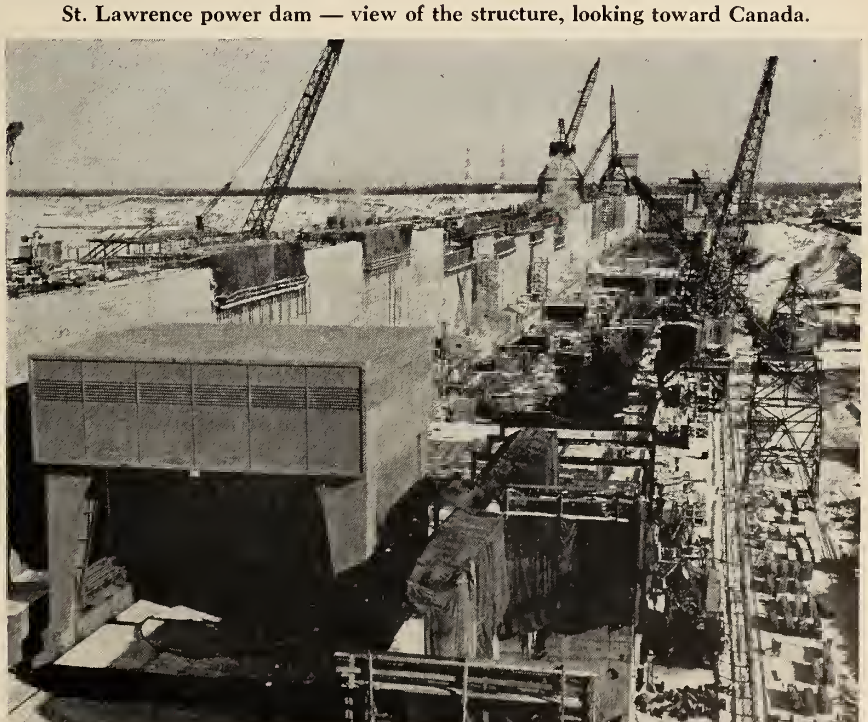
Four cells of the downstream cofferdam will be removed, starting in April, in preparation for passing water through the plant to test the first units to go 'on line' after the pond is raised. Drilling of the upstream earth cofferdam, preparatory to blasting it in July, is already under way.

On the Long Sault dam, with work 90 per cent done, second stage cofferdams were being removed. Placing of concrete was continuing intermittently from the power-house mixing plant on north bulkhead blocks. In March, placing of concrete will be resumed on the rollaways in stage I from pontoons on the downstream side. Diversion of the flow through the stage II tunnels will be commenced after the ice goes out of the river.

Elsewhere, the Massena intake was completed, as was the Iroquois dam with exception of removal of the last piece of cofferdam. Operation of the dam was commenced in mid December by Ontario Hydro.

Dikes on the American side were completed except for two gaps left for railway spurs. Dredging for channel improvement at Chimney Island was completed, as also was the dry excavation of the channel at Sparrowhawk-Toussaint, though dredging at the latter was continued on the rim dike throughout January. Channel excavation with exception of cofferdam removal was also completed at Point-Three-Points, Leishman's Point and Ogden Island. At all of the places the channels were adequate for 14-foot navigation. January was marked by completion of reservoir clearing, several months ahead of schedule.

St. Lawrence power dam — view of the structure, looking toward Canada.



Progress by SLSDC

With concrete excavation and dredging closed down for winter, employment was sharply reduced to some 400 persons. At the Eisenhower lock there remained some 200,000 cubic yards of earth to remove at the downstream approach, while excavation of road approaches and completion of the highway underpass paving was deferred until spring. With gate installation completed, work on installing machinery and electrical controls was proceeding.

At Grass River lock 700,000 cubic yards still remained to remove from a 'plug' to make 27-foot navigation possible. A third of this material must be removed before July to permit 14-foot navigation. Lock gates were installed and installation of electrical controls was under way. On the mainland section of the Long Sault canal, now 97 per cent finished, only some 200,000 cubic yards remained to be cleaned out of the bottom.

On the Cornwall Island channel, some dredging remains to be done for 14-foot navigation on the American side next spring, but excavation at Raquette Point was completed. On the Canadian side work was continuing on schedule during the winter months. There was only one point on Cornwall Island to be removed to permit 14 ft. navigation.

On the new high level highway bridge at Cornwall, new rings of steel sheet piling had been driven around the pier base to permit additional grouting. This work, interrupted by winter weather, will be resumed in the spring after the ice goes out. Except for this grouting, piers and approach trestles were completed. The old bridge was still in operation but ferry docks were being built at each shore. A ferry had been delivered and was being assembled. A contract had been awarded for the superstructure steel, but delivery had not commenced.

Progress by SLSA

Locks: On the St. Lambert lock excavation was continued during January with some 125,000 yards removed. Placing of concrete had been suspended in December with some 4,000 cubic yards left to complete with ready-mix. At lower end the stiffleg derrick had been set up and stoplogs were being placed. Installation of taintor gate valves had been started. Gate installation had not been started. With the trunk sewer completed along the south shore, regulating gates were being installed at the north end. The cofferdam in the excavation was practically completed on the upstream approach; while water had been let in at the lower end of the lock.

At the Cote Ste. Catherine lock, while no concrete was being placed this winter excepting small amounts of ready-mix, excavation of rock was being continued, with 1½ million yards removed to date. Bedded parts were being installed for the sector gates and the lower installation of mitre gates and electrical equipment was proceeding.

At upper Beauharnois lock, excavation was continuing and some 22,000 yards of rock removed in January brought total to date to over a million yards. Placing of concrete had been stopped at year-end. Excavation was proceeding in the canal upstream. On the lower Beauharnois lock, with placing of concrete closed down, excavation was proceeding. One derrick had been erected and the upstream stoplogs had been installed, but no gate erection had been started.

Bridges: At Victoria bridge, erection was proceeding on the vertical lift span, building it around the tracks which were temporarily supported on falsework. On the Jacques Cartier bridge, all bailey bridges, falsework and erection trestles had been removed and jacking up of the superstructure was continuing on schedule. On the south end of the Mercier bridge, erection of the structural steel deck spans was proceeding at three places, with four spans completed in places. On the C.P.R.-N.Y.C. rail bridge at Caughnawaga, with both north and south approach spans erected, work was proceeding on the lift spans, with the portions which lift installed on one track and proceeding on the other.

Other Seaway News

Welland Enlargement

A new Welland canal, costing some $75 to $100 million, will be needed within 10 years if the seaway is to carry its full potential and pay for itself in 50 years. Toll plans will assume Canada will build this duplicate canal soon enough to allow full development of traffic. In all Canada-U.S. negotiations Canada has been given credit for the $132 million spent on the Welland up to 1932. But the existing Welland locks will impose the limit on through traffic after the seaway is opened in 1959. Seaway authorities are counting now on a traffic build-up to 65 to 70 million tons by 1970. Prospects of this large expenditure in the near future is one of the major reasons against keeping the canal free of tolls. Canada will want to keep the reconstructed Welland on the same self-liquidating basis as the rest of the seaway. The greater volume of traffic will also make possible, it is believed, a rate of tolls close to the level the Seaway's advocates in the U.S. assumed in 1953.

Dominion Marine Association

At the annual convention in January the D.M.A. proposed that an experimental toll collection system be established for the seaway, but that no actual tolls be collected for three to five years.

Admiral Lyndon Spencer, president of the U.S. Lake Carriers Association, felt personally there should be no tolls. "Let's pay it off in taxes and be done with it", he said. But his association would not oppose tolls, he added. He did not see what could be accomplished by setting up a tolls system without actually collecting tolls.

D.M.A. officials also consider it of vital importance that facilities built on Canadian territory should remain under Canadian control, whatever the policy of the U.S. government. A joint toll agreement such as appears possible under provisions of the Seaway Authority Act was viewed with alarm. Any agreement at Authority level could have the same effect as a treaty commiting Canadian territory to control by a foreign body. Imposition of a single tolls system over which Canadian government would lack complete sovereignty, must be avoided, D.M.A. warned.

SLSA President Charles Gavsie, stated on January 28, that "it is fully expected that 27-foot channels being dredged under contracts awarded by the Authority will have been completed by the opening of navigation in 1959 to a stage that Seaway shipping will be accommodated safely". This was in answer to the opinion expressed by DMA President, Captain R. B. Angus earlier that there were doubts as to the completion of the seaway for the Spring of 1959 because of dredging having fallen behind schedule.

Such work as will remain to be done during the 1959 season of navigation would not unduly restrict or be hazardous to shipping, said Mr. Gavsie. Expectations were that at the opening of navigation in 1959, the channel will be fully completed from Montreal harbour through the Laprairie Basin, Lake St. Louis, Beauharnois canal and Lake St. Francis.

The SLSA portion of the south Cornwall channel will be dredged to full depth for a minimum of 400 feet prior to the opening of navigation in 1959. The channel approaches above and below the Iroquois lock will be fully completed. The improvement of the Thousand Islands section by removal of scattered shoals will be completed to a minimum width of 400 feet. The deepening of the Welland chip canal will be completed.

The turning basin at the entrance to Montreal harbour will not be completed during 1958. This may necessitate the turning of large vessels further downstream, within the harbour.

Mr. Gavsie also referred to a statement made by Captain J. S. Walton. Commodore of Colonial Steamships Ltd. fleet, that the currents in the approaches to Iroquois lock would make unsafe the handling of large Great Lakes vessels when the 27-foot navigation is opened.

An inspection was made on January 29 of the Ontario Hydro hydraulic models at Islington, by two groups of Great Lakes steamship operating personnel with particular reference to the Seaway Authority's Iroquois lock. Among the officers present were Captain Scott Misener, President of Colonial Steamships, and Capt. Bruce Angus, President of the Dominion Marine Association.

All present were satisfied that conditions that will exist in the downstream approach will be excellent and present no difficulties to navigation. A cross-current at the upstream approach will render navigation a little tricky, but consensus of opinion was that when the masters of vessels become familiar with conditions there will be no obstacle to safe navigation.

U.S. Railways Behind Free Port

A group of midwest and western U.S. railroads are reported considering using Chicago as a mammoth terminus for future seaway traffic. They would incorporate a steamship company and use Mortier Bay on the south coast of Newfoundland as an eastern terminus, trans-shipment and processing point for inbound and outbound goods.

Mortier Bay is an undeveloped, almost fog-free port. A free port there would involve investment of hundreds of millions.

Deas Island Tunnel

The four-lane, 2,100-foot tunnel under the Fraser River at Deas Island, B.C., will connect Vancouver via Lulu Island with a new highway to the U.S. Border. It is scheduled for completion next year.

Total length of the crossing including approaches will be 8,000 feet.

Concrete sections are built in drydock, floated into position, sunk in a prepared trench and then joined. Since these pictures were taken, one of the elements has been floated into position and sunk.

The sections are 344 feet long, 78 feet wide and 24 feet high, each containing two tubes with 24-foot roadways. Roadways are separated by concrete bulkhead, and a duct at the outside of each roadway is provided for ventilation, wiring and drainage.

When completed, the tunnel will be capable of handling 7,000 cars an hour. It will contain 100,000 yards of concrete, 12,000 tons of steel, and will require 2.5 million cubic yards of excavation and backfill, plus 200,000 yards of riverbank protection. Total cost is expected to be $16.6 million.

It is one of six major crossings being undertaken by the B.C. Toll Highways and Bridge Authority. It was designed by, and is being built under supervision of the joint venture of Foundation of Canada Engineering Corp. Ltd., and Christiani & Neilsen of Canada Ltd.

Canadian Pipeline Projects

The natural gas industry of Canada can look back on 1957 as a year of solid accomplishment. Eight months production at 206 billion cubic feet was up some 22 per cent over the 169.2 billion feet for the previous year.

All main pipeline projects scheduled for completion in 1957 were laid, tested and filled. Several cities and many smaller communities were already using natural gas for the first time. Some 2,000 miles of main gas lines, 2,300 miles of laterals and distribution mains had been laid during the year.

Yet natural gas, after nine years as a political football, was still a resource without adequate assured markets, whose owners do not know when or if they will be permitted to serve markets currently open to them. The result; — increasing economic pressure on all members of the industry from the $150 million of non-revenue producing capital so far tied up in gas lands and capped wells.

The consensus of opinion among producers is that regardless of what happens before the next election, there is not the slightest chance of the Federal Government reversing its policy on export immediately. They look for a long, tough, and possibly unrewarding fight.

Canada's bargaining position in respect to oil exports is also weakened by the persistent refusal to commit ourselves officially to a policy of liberal gas export. This is a challenge to the Alberta government as well as to Federal authorities. Alberta has not stated how much gas it is prepared to declare surplus beyond quantities now committed. If such a statement were made it would demonstrate Ottawa had no reason to suspend action about a matter on which operators and the local conservation authority are in complete accord.

Westcoast Transmission

Westcoast Transmission attained a throughput volume of 300 MM c.f.d. average by the middle of January in its mainline from Taylor to Huntingdon, B.C., according to the annual report for 1957, released January 8. "In the short period between the official opening on October 8th and year end, deliveries were being built up to Inland, to B.C. Electric and to Pacific Northwest Pipeline Corp."

Trans Canada Pipelines

Trans Canada Pipelines early in January announced awards for contracts on the 486 miles of 30-inch pipeline to be built this year from Kapuskasing to Maple, Ontario, near Toronto.

Spread 9: 83 miles from Potter to main highway southwest of Kirkland Lake; — to Majestic Contractors Ltd. This spread is entirely in the clay belt, with glacial till and boulders.

Spread 10: 57 miles from Kirkland Lake to Rib Lake; to Dutton Williams Brothers Ltd. Starting in the clay-belt this spread merges into granite rock terrain in the southerly half.

Spread 11: 47 miles from Rib Lake to near Tilden Lake; to Canadian Bechtel Ltd. The spread is almost all in granite rock.

Spread 12: 62 miles Tilden Lake to South River, passing through North Bay; to Morrison Shivers Ltd. The spread has some granite at the north end, but merges into sandy clay and sand to the south.

Spread 13: 63 miles from South River to Bracebridge; to Price Poole Ltd. Starting in sandy clay, the spread runs into granite at the south.

Spread 14: 92 miles Bracebridge to Maple: to Oklahoma Constructors Ltd. Traversing the rest of the granite rock as far south as Orillia the spread merges into sandy pine country to Barrie then through cultivated farmland to Maple.

Start of pipelaying is planned for about May 1st. Major water crossings to be let separately are over the Kapuskasing, Groundhog, Mattagami, Wattabeag and Muskoka rivers, and Gull Lake.

Delivery of natural gas to the Lakehead cities of Fort William and Port Arthur was officially commenced at the end of January.

Inland Natural Gas

Almost 90 per cent of the homes in the B.C. interior connected for natural gas are using the fuel for heating. Sales of gas-fired heating equipment in the 27 communities served by Inland Gas were estimated by appliance dealers at 4,000 units in the last quarter of 1957.

Winnipeg and Central Gas

Plans for reorganization of the Company were announced in mid-January. Many problems are facing it and it may be necessary to change the Company's name. Blame for the Company's position was placed on representations during 1957 by other gas utility interests to some of the municipalities in the Greater Winnipeg area. The publicity accompanying these representations plus a deterioration in national security markets had so far made it impossible to arrange a long term financial program. If terms of reorganization are implemented, prominent interests in the utility field will participate in the company's new financing.

Northern Ontario Gas Sales

The first major contract for sale of natural gas to industry in Northern Ontario was completed in January. A contract was signed between Twin City Gas Co. and Abitibi Power and Paper Co. for delivery of 20.8 billion cubic feet of gas over a 10 year period at a cost of $7.7 million. This represents a major portion of Abitibi's fuel needs for its three mills at Port Arthur and Fort William. Another important gas sales contract has been made with Canada Malting Co. at Port Arthur. Further east, Northern Ontario Natural Gas Co. and affiliated companies with an extensive franchise area in north-western Ontario is negotiating large sales contracts with four other pulp and paper companies. Work on distribution systems in Kenora, Dryden and Fort William and Port Arthur is on schedule. Twin City has installed 41 miles of an eventual 300 miles of distribution lines.

Consumers Gas Company

An aggressive sales campaign throughout the greater Toronto area, second largest residential market in Canada, has brought about connection of natural gas to some 75 per cent of all single family houses built last year in the greater metropolitan area, while almost two thirds of them have water-heating service also installed. Virtually every major builder of small and medium priced houses in the area has either swung over to gas service or plans to do so at an early date.

Lakeland Natural Gas

Lakeland has completed the first stage of construction of its gas distribution facilities costing $2 million in Port Hope, Cobourg, Trenton, Belleville, Napanee, Gananoque, Prescott and Cornwall. Delivery of gas will commence early in February in all eight communities.

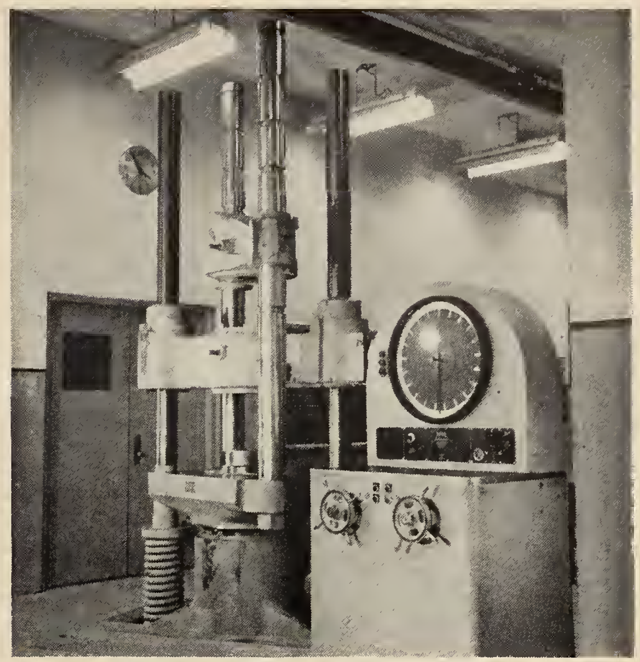
Quebec Natural Gas

A new rate structure is being prepared by company officials for submission to the Quebec Electricity Board. New rates will not come into effect until after the entire city has been converted from manufactured to natural gas about the end of May 1958.

Alberta and Southern Gas

Alberta and Southern Gas Co. Ltd. has more than enough natural gas under contract or option with Alberta producers to supply the 450 million c.f.d. specified in its application to the Alberta Conservation Board. Contracts are signed with a dozen leading producers in addition to those previously announced with Shell and producers in the Pembina field. New contracts cover supplies from the Dick Lake, Pine Coulee, Holmglen Rimbey, Minnehik, Cattle River and other areas. They cover deliveries adding up to some 175 million c.f.d.

Low speed wind tunnel at U.B.C.



Baldwin-Southwark testing machine.

The Faculty of Applied Science of the University of British Columbia

The University of British Columbia has undertaken "The Plan for 1965", a development program which would correct physical deficiencies and provide for another, greater and permanent influx of students now developing.

The university, with a student body which at the end of World War II more than doubled in one year to a figure of 6,600, now comprises ten faculties and five schools, as compared to its three faculties of 1944.

The development program will affect the university as a whole, providing urgently needed buildings and services, and it will benefit the faculty of applied science in the form of an engineering building at an estimated cost of $2 million.

In the meanwhile, as Dean H. C. Gunning of the faculty of applied science reports, only one small engineering building has been added in recent years—for physical metallurgy.

About $15,000 of capital has been spent on modernizing and improving the accommodation in various departments, particularly in chemical engineering and electrical. The special need was improved laboratory facilities and increased space and equipment in shops to handle the increased amount of research work at the undergraduate and graduate levels.

To meet the needs of a greatly enlarged enrolment, there are preliminary plans for building construction for the faculty as follows — subject to readjustments as time passes and enrolment estimates are adjusted.

The first phase — 1958-1959 — would provide 80,000 square feet of space chiefly for chemical, mechanical, electrical and metallurgical departments.

The second phase — 1960-1961 — would provide 92,000 square feet. This is for the same departments, but it also includes extra space for the first two (common) years of engineering and extra office and research space for civil engineering.

The third phase — 1962-1963 — would give 47,700 square feet. This is additional space for mechanical, civil, electrical, mining and metallurgy.

These plans should meet the needs of the faculty until about 1965, Dean Gunning reports. The program envisages the eventual abandonment of about 50,000 square feet of temporary buildings that are at present occupied by all the departments except civil engineering.

New equipment

The major items of new equipment obtained recently are:

I. 400,000-lb. Baldwin - Southwark testing machine for the civil engineering department;

II. 60-k.v. X-ray fluorescent analysis equipment, by Philips, jointly for the departments of metallurgy and geology;

III. Low speed wind tunnel, in the department of mechanical engineering.

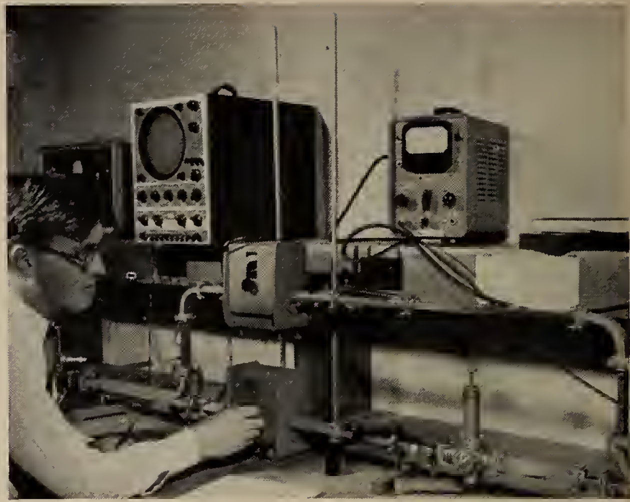
This wind tunnel, designed by Dr. G. V. Parkinson of the department, was first put into operation in July, 1957, and is still being subjected to a program of calibration prior to its general use in student laboratory work and faculty and graduate research programs.

It is of the horizontal, closed-circuit type, with enclosed test section. Through a modified Ward-Leonard drive system, a motor-generator set

The *Journal* Reports Growth in Engineering Faculties in Canada

Third article of a series.

Electronics research — gaseous discharges.



Microwave research — multi-mode cavity filter.

supplies up to 15 horsepower to a d-c motor driving a commercial axial-flow fan. This fan provides airspeeds up to 100 m.p.h. through the test section, which is 3 ft. by 2¼ ft. in cross-section, and 8-2/3 ft. in length. A nozzle upstream of the test section accelerates the air flow to the required velocity, and improves the flow uniformity. The use of a settling section 6¾ ft. by 6½ ft. in cross-section, and 5-2/3 ft. long, containing up to three fine mesh wire screens, upstream of the nozzle, also improves the flow uniformity, and reduces the turbulence level. The settling section is also used as an auxiliary test section for testing large models at low speeds.

The tunnel airspeed can be set accurately to any value up to the maximum by adjustment of generator and motor field rheostats on the control panel, the airspeed being inferred from the reading on a micromanometer connected across piezometer rings upstream and downstream of the nozzle.

The tunnel will be used as a laboratory tool in aerodynamics and fluid mechanics instruction, and as a research tool by faculty and graduate students.

Calibration results to date indicate that the air flow is satisfactorily uniform, and that the tunnel can be run successfully by one person for many types of test. Some useful data have already been obtained on building roof patterns and pressure distributions from model tests in the settling section, and studies of aerodynamically excited vibrations will soon be started in the test section.

Construction of the tunnel has been made possible by National Research Council grants.

Equipment additions in the mechanical engineering department over the past few years have also included: two new lathes; a hair-pin heat exchanger from Brown Fintube (Canada) Ltd.; several items of instrumentation and electronic strain gauge equipment obtained mainly from funds supplied by N.R.C. grants in aid of research.

A workshop acquired in chemical engineering by rearrangement of space will facilitate the modernization and extension of laboratory teaching equipment.

Courses and Curricula

The department of electrical engineering during the past year has continued to improve its facilities both for undergraduate and post-graduate instruction. The undergraduate program has been re-examined and two general options introduced. One is a course of studies along traditional lines with the usual emphasis on technology. Both power and electronics are covered. The second is a course in which greater emphasis is placed on the mathematical and physical bases of electrical engineering, and attention is directed toward the information and energy processing aspects of electrical engineering.

In March 1957 the university installed an Alwac III E digital computer as an aid to scientific research on the campus. The project is being financed by local industry, the Defence Research Board and the National Research Council. The department of electrical engineering has accepted the responsibility for the technical supervision of the computing facility as well as provision of courses of instruction on both digital and analogue computing devices.

The research facilities in the department have been extended particularly in the fields of micro-wave research, analogue computation and control systems. Current research projects include ferrite micro-wave devices, multi-mode filters, general purpose analogue computer, variable torque induction motors, speech compression, studies in gaseous discharges, delta modulation, medical electronics, electronic isograph and klystron amplifier design techniques.

The curriculum in mechanical engineering has recently been revised with the emphasis being placed on the theory and scientific basis for engineering decisions rather than on past practice. The elementary metallurgy course has been shifted from the fourth year to the third to allow an option in design and metallurgy for students who wish more training in physical metallurgy to better fit them for today's difficult problems of material selection and design.

A course in industrial engineering has been introduced which is taken by all mechanical engineers. This course requires considerable outside reading, and is expected to help in improving the ability of the students to express themselves well in speech and in writing. To this end also, a course in English was introduced into the third year a couple of years ago.

In the session 1958-1959 it is intended to begin accepting in the department of chemical engineering post-graduate students working for the degree of Ph.D.

Civil engineering is considering consolidation of some of its courses on soil mechanics, foundations and earth pressures. It is also giving serious consideration to optional courses for juniors and seniors. Metallurgy has provided a number of options, in physics, chemistry, and mechanical for its upper year students and has attracted and will attract a large number of students from the other engineering departments by providing suitable optional courses in metallurgy. The first year course in physics has been broadened to include more modern physics, and this necessitates some adjustments in engineering courses in statics, dynamics and strength of materials. The course in geological engineering is being adjusted to include more training in basic photogrammetry and in soil mechanics.

All departments are placing greater emphasis on research at the undergraduate and graduate level, and several of them are making use of the new digital computer.

The emphasis on the humanities continues to expand by the inclusion in the curriculum of more class or seminar work in English, human relations, and basic economics. Voluntary work in these areas is encouraged.

Kelowna Floating Bridge

To the middle of January work on the Kelowna Floating Bridge, being constructed for the B.C. Toll Highways and Bridges Authority was approximately two-thirds complete and at the present rate of progress the bridge will be in operation on or before the scheduled completion date at the end of August.

Construction of the concrete pontoons and the lift span piers has been completed without any serious difficulties arising. The contractor's graving docks, concreting facilities and cell forms, as described in a previous article (*Engineering Journal* April 1957) were very well planned and were mainly responsible for the excellent progress achieved.

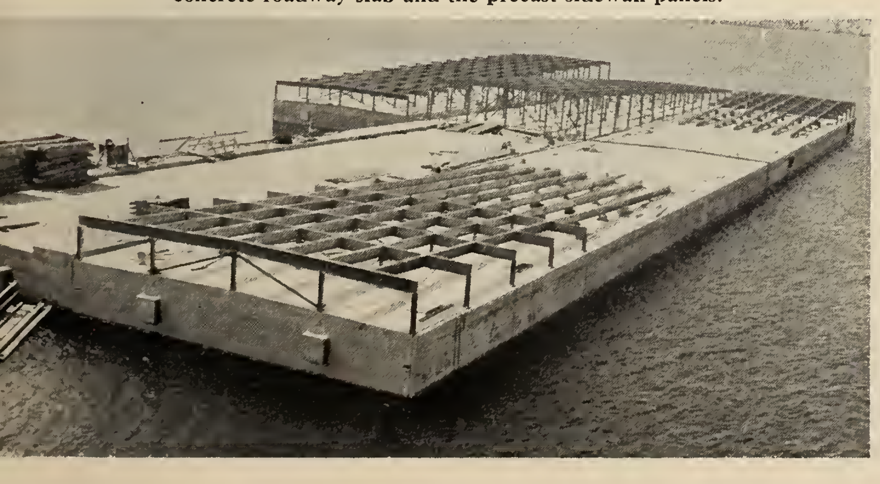
The contractor is now placing the concrete anchors which will hold the pontoons in position. The first pair of these anchors placed did not reach a sufficient embedment and it was necessary to redesign the jetting system. One of these anchors projected only two feet above the bottom and its embedment was later increased by backfilling with pit run gravel. The other anchor was raised, the bottom excavated and the anchor then placed in the excavation which was also backfilled with pit run gravel.

The original jetting system consisted of 21—1 in. diameter and 1½ in. diameter jets cast into the concrete anchors and a pump supplying about 1,200 U.S. g.p.m. The new system attached to the face of the anchor walls has 16—2½-in. jets and three pumps with approximately three times the original capacity. The majority of the anchors placed with this new jetting system have reached the required embedment and those few that do project slightly above the bottom will be covered with pit run gravel.

The final phase of this work, connecting the pontoons to the anchor cables, will be underway shortly and should be completed in March.

The Dominion Bridge Company started erection of the steel trusses early in January. By the end of May they intend to complete the erection of three approach spans, two lift span towers and the lift span.

Structural steel in place on the superstructure pontoons ready for the lightweight concrete roadway slab and the precast sidewall panels.



What Goes On

Bell Telephone

The complete microwave network from Sydney, N.S., to Victoria, B.C., will be operational in 1958.

The network carried telephone and television west in 1957, and linked Quebec and Saint John, N.B., in February 1958, adding the Maritime network. Links between Montreal-North Bay-Sudbury-Sault Ste. Marie were being developed in 1957 — as well as a chain between Montreal and New York. Nipigon, in Ontario, Goose Bay, in Labrador, Seven Islands, Quebec, and other northern centres have or will have new or better communication by means of links with the Trans-Canada Telephone System.

Niagara Falls Power

Hydro Electric Power Commission of Ontario reported at year end that work at Niagara Falls was going ahead rapidly on the installation of four additional units at the Sir Adam Beck-Niagara Generating Station No. 2. By the end of the year two of these generators were in operation, while the other two will come into service by the summer of 1958. These, together with the 12-unit-phase completed in 1955 and the associated pumping-generating station will bring the total capacity of this plant up to 1,370,000 kilowatts.

Hydro started work in August, 1953, on the pumping-generating project and a 750-acre reservoir with a capacity of 650,000,000 cubic feet. By the end of 1957, the first three of six units were in operation. A particularly interesting feature of this unique undertaking is the reversible type of turbine-generator which was designed for this station. During low power demand periods, the units, operating as pumps, lift water from the power canal into the reservoir. Then, at peak demand periods, by the simple moving of a switch, they operate in reverse to act as generators. In this process, the water is discharged back into the canal, permitting fuller use of all generating units in the Sir Adam Beck-Niagara generating stations.

At Niagara Falls also, the far-reaching Remedial Works Program, carried out by Ontario Hydro and the Corps of Engineers, United States Army, was officially completed in September.

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

IAESTE Annual Conference

The Engineering Institute participated in the annual conference of IAESTE which took place in Madrid, Spain, in January, with the Spanish IAESTE committee acting as hosts. This non-political, non-profit association of 22 nations (The International Association for the Exchange of Students for Technical Experience) is the agency which has for 10 years been placing undergraduate engineering students in positions abroad during the vacation prior to their final year. These students then return to their own countries to complete their courses.

Professor J. Pazo, of Spain, was elected as conference chairman. Canadian delegate to the Madrid conference was E. C. Luke, assistant general secretary of the E.I.C., who is secretary of the Canadian national committee of IAESTE. Administration of the exchange is provided for Canada through E.I.C. Headquarters.

Mr. Luke's report of the proceedings told of discussion of points of exchange administration, of treatment of applications for admission of Greece and Tunisia, and of the decision that the next conference will be held in Istanbul, Turkey in January, 1959, and the following one in 1960, in Yugoslavia.

A forecast of the new year's operations disclosed that exchanges can be anticipated at about 5,300 in 1958, showing a slight downward trend which is thought not to be a serious development. A slight increase in national subscriptions was called for in view of higher administrative travel costs. A recommendation was adopted that an IAESTE publicity leaflet be prepared in English, for distribution by all interested countries. Translations were to be considered later.

James Newby, of Great Britain, relinquishing his post on the IAESTE advisory committee, was tendered an enthusiastic vote of thanks for his excellent work and long association with the exchange plan, actually dating back to its beginning.

Observations reported by Mr. Luke to the Canadian committee and E.I.C. Council commented on the dignity and friendly atmosphere of the conference. The European nations attach great importance to the IAESTE plan, whereby nearly 35,000 students have now been exchanged. The opinion is evident that of all the international movements started after the war, IAESTE has grown and prospered probably more than any other, and is therefore a considerable influence for mutual understanding and peace.

IAESTE Conference, Madrid: Delegates at the first plenary session, January 13, by countries, right to left: Canada, India, Sweden, Spain, Denmark, Italy, France, Netherlands — (remainder not identifiable).

The Eastern Field Secretary

John A. McLaren is the new eastern field secretary of the Engineering Institute, with offices in Toronto, having succeeded Colonel L. F. Grant, who retired at the end of 1957.

Mr. McLaren was born in the Ottawa Valley at Cobden, Ontario. He attended Brown's School in Toronto and Beamsville High School, and the University of Toronto from which he received the degree of B.A.Sc. in chemical engineering in 1931.

John A. McLaren, M.E.I.C.

He commenced his career as assistant engineer in the Division of Sanitary Engineering of the Ontario Department of Health, and was for two years in the research and control laboratory of the Brewing Corporation of Canada. In 1936 he went to Wm. R. Warner to set up a control laboratory, later becoming assistant superintendent, and finally plant superintendent for that company. During the war years, 1940 to 1945, he was with Defence Industries Limited, first at Nobel where he was a supervisor during the start up of the cordite manufacturing operation and later superintendent of the T.N.T. plant. Then, at the Villeray fuse filling plant, as superintendent of quality control, he was in charge of the technical and inspection staff.

Since the war, Mr. McLaren has been engaged in management, being connected with Lyman's Limited and Lyman Agencies as general operations manager; organizing and managing Georgian Bay Airways Limited; acting as secretary-manager of the Sudbury and District Chamber of Commerce during 1949 and 1950; leaving that position to organize Leland Sales (Eastern) Limited, in Toronto, and later acting as technical and financial consultant to the firm.

He became a Member of the Engineering Institute of Canada in 1950, and has been a Fellow of the Chemical Institute of Canada since 1943.

Mr. McLaren and his staff are actively concerned with assisting branches and student sections of the Institute in Eastern Canada. Mr. McLaren's particular attention will be paid to assisting the branches and sections in obtaining speakers, organizing Professional Development Courses. For those members who reside too far from the nearest branch to take part in branch activity, he will attempt to provide personal contact with the Institute, so that each member may continue to enjoy the services which the Institute offers to its members.

Correspondence

"Daylight through the Mountain"

Dear Dr. Wright,

Mr. W. A. Deacon, literary editor of the Globe and Mail, Toronto, has recently assigned to me the pleasant task of reviewing the new book by the Walkers, "Daylight Through the Mountain". I have read and reviewed it with much interest and profit, and am of the opinion that it is a quite valuable addition to Canadian Letters.

May I also express my gratitude as an engineer to the Engineering Institute for the support given to Canadian arts in the publication of such material.

W. F. SUTHERLAND, P.Eng.
Toronto, November, 1957.

THIRTY-FIVE YEARS AGO

Comment on the Journal of March, 1923

The March 1923 issue of *The Engineering Journal* indicates some of the great trends that have developed in engineering over the past three to four decades. Two of the four papers published in the issue emphasize how Canadian developments in the past ten years have changed our thinking and re-directed it into different channels.

The first of these papers deals with railway electrification. In the 'twenties' Canada, conscious of the rising prices for coal and of the vast potential of the nation's water power, was watching electrification of railway lines in the United States and noting the implication it had for Canada's many rail lines. Little did we suspect that in the 'fifties' with great oil discoveries, Canadian railroads and even railroads in the United States would be almost completely dieselized.

The second paper, pointing to the lack of coal deposits in Central Canada and the abundance of low grade ores of Northern Ontario, advocated the conversion of these ores electrically. Today, with vast resources of rich ore available from Ungava and Northern Ontario, with shortages of electric power facing Ontario and Nova Scotia and with new processes such as oxygen furnaces, being developed, there appears much less incentive to add to the 12 per cent of ingot capacity where low grade ores are now converted electrically, nor for that matter to the 80 odd steel furnaces now electrically operated either, except along the lower St. Lawrence river.

The section devoted to Branch News also contained abstracts of papers presented at branch meetings which, when read thirty-five years later, further emphasize new trends in engineering practice. A paper presented to the Hamilton Branch drew attention to the use of rolled rail steel for reinforcing. Today it is almost universally accepted for this purpose. The Saint John Branch heard an address pointing to highway engineering as an 'important engineering project'. Today's expenditure for Canadian highways of some $800 or 900 millions annually would have surprised the listeners.

At the Toronto Branch, Canadian radial lines were discussed. Today the electrified radial lines have all but disappeared, their place being taken by gas or diesel driven bus and coach lines, and the automobile. The Peterborough Branch heard a paper on 'the chemistry of the insulating varnishes'. But advances in the art of insulation for electrical apparatus have brought about tremendous changes and improvement.

Other papers presented,—to the Saint John Branch on land surveying; to the Calgary Branch on "The Aeroplane"; to the Toronto Branch on meteorology, could not visualize the far reaching changes that have been developed since 1923; air surveys, 'Shoran', Canada's huge aircraft industry and worldwide airlines; and the remarkable accuracy of weather forecasting today.

Reading the *Journals* of thirty-five years ago draws one's attention to an improvement in the presentation of papers and addresses. This is the current custom of briefly summarizing the contents of each paper in a 'box' at the beginning of the article.

The Association in 1923

Membership of Associations of Professional Engineers in Canada was recorded as follows: Alberta 321; British Columbia 603; Manitoba 306; Ontario 479; Quebec 905; New Brunswick 176 and Nova Scotia 240 a total of 3,030. Of the total exclusive of Quebec which gave no breakdown, some 60 per cent of the six other associations reporting recorded 60 per cent of the membership were civil engineers. *H.G.C.*

Did You Know That . . .

Close to 20,000 copies of this issue of the *Journal* have been printed and distributed. It costs about twelve thousand dollars to print one issue of the *Journal*.

Elections and Transfers

A number of applications were presented for consideration and on the recommendation of the Admissions Committee, the following elections and transfers were effected at a meeting of council held at Calgary, Alberta, on January 25, 1958.

Members: R. G. Billinghurst, Windsor; E. J. Bobyn, Quebec; J. W. Bradstock, Toronto; D. C. Brazier, Toronto; F. A. De Marco, Windsor; I. J. Dickinson, Rossland; J. S. Ellis, Kingston; P. G. Goldsbro, Trail; K. Holbek, Oakville; W. J. Horton, Baie Comeau; W. R. Keating, Baie Comeau; Z. P. Kekes, Montreal; T. M. Lees, Corner Brook; F. Machin, Montreal; J. Manuel, Montreal; F. R. Mottershead, London, Ont. G. E. Plant, Vancouver; G. W. Scott, Baie Comeau; D. L. Servage, Windsor; J. H. Seymour, Toronto; P. H. F. Shanks, Montreal; D. L. Spanjer, Montreal; A. R. White, Peterborough; C. B. Woodley, Lakeside.

Juniors: A. A. Allart, Port Credit; D. Atkinson, Toronto; K. J. Barkley, Halifax; D. D. Craig, Montreal; J. O. Down, Danville; J. F. Macleod, Calgary; T. A. Qureshi, Toronto; J. N. Raftis, Sudbury; T. J. Stephen, Saint John, N.B.; P. G. Wilson, London, Ont.; V. S. Zachovay, Montreal.

Junior to Member: A. F. Barnard, Hamilton; E. E. Bredin, Sarnia; R. E. Chamberlain, Montreal; D. A. Foster, Moncton; A. P. Kilroy, Montreal; P. H. Langlais, Quebec; R. A. F. Latham, Toronto; R. W. McMeekin, London, Ont.; J. Sylvester, Montreal; C. R. Thompson, New York.

Affil. to Member: D. F. Rhodes, Sarnia.

Affiliate: J. A. Forsyth, Vancouver.

STUDENTS ADMITTED:

Queen's University: W. A. Anderson, T. R. Beamish, R. G. Beckman, J. F. Boadway, S. Bosnick, L. F. Buttner, T. E. Callaghan, D. A. Dunsire, P. G. Falkner, R. A. Fuller, C. A. Giovanella, S. W. Guzik, H. R. Hanson, W. H. D. Harris, A. T. Hawkins, R. H. Healey, D. L. Heins, T. A. Hickey, R. D. S. Holmes, J. H. Hutt, R. G. Johnson, D. J. G. Lamarre, R. J. Mackinnon, R. E. MacLaren.
H. R. B. McIntyre, B. D. McLaughlan, R. F. Mikitish, J. T. Milton, W. P. Nolting, H. C. Organ, R. W. Penty, A. J. Pouti, R. M. Pow, E. J. Richards, R. F. Robertson, G. M. Royer, G. A. Schultz, E. F. Schutt, D. D. Smith, D. A. Sutherland, J. M. Van den Berg, M. P. Varcoe, L. B. Webster, J. D. Wilford, S. C. Wilson, W. J. Wilson, O. Zawalsky.

University of Toronto: H. K. Anderson, D. F. Barr, G. N. G. Birch, S. M. Blumenfeld, D. E. Cass, D. L. Comish, S. Fedchak, Z. W. Fedun, P. C. Grace, G. W. Haight, P. B. Long, R. S. Lougheed, J. S. Preece, E. B. Smythe, J. A. Tattle, S. L. Webster.

Memorial University of Newfoundland: E. W. Bown, S. G. Dyke, G. A. Hill, R. L. Janes, G. W. Moores, E. G. Paul, G. R. Peters, C. L. Powell, G. H. Simms, A. Strauss, H. F. Young.

University of Alberta: R. S. Daniels, R. E. Listander, J. W. Twach, A. Willumsen.

Royal Military College: R. Dube, J. W. Y. Lemieux, T. A. London, R. C. Salmon.

Acadia University: R. C. Demmings, J. E. Hutchinson, A. L. McEachern, J. D. Winter.

Univ. of Western Ontario: G. S. P. Castle, T. B. Collings, S. R. Hunt, D. R. Thomson.

Sir George Williams College: H. C. Deys, R. T. Ratony, P. C. Sakany.

Laval University: Y. R. Bourassa, C. E. G. Lafrance.

McGill University: B. F. Rumsey.

Univ. of Saskatchewan: I. H. Brockman.

Graduates: J. M. Campbell, B.A.Sc., (Civil) 1957 Toronto; N. M. Laughlen, B.A.Sc. (Elec.) 1957 Toronto.

Applications through Associations

By virtue of the co-operative agreements with the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Member: E. W. Abercrombie; **Junior to Member:** R. D. Grantham, R. Pilkington, E. Sherwood; **Student to Junior:** A. G. Swanson.

SASKATCHEWAN

Member: R. M. Bailey; **Junior:** G. B. Babej.

NOVA SCOTIA

Junior to Member: B. W. Allen, L. S. Prikler.

NEW BRUNSWICK

Junior to Member: B. W. Cosman.

French Government Scholarships For Canadian Engineers and Technicians

Several thousand foreign students are working in French institutions, universities and laboratories in many fields of knowledge. The number of engineering and technical students, in particular, has greatly increased since the war on account of the importance of techniques which have been discovered or perfected in France. These students have arranged to take formal courses or to do practical work in industry, often combining both. It has become necessary to organize and co-ordinate these professional "stages". The French Government has created a service to this end (Service de Coopération Technique) and has endowed a great many scholarships, a number of which have been reserved for Canadian engineers or technical men of similar standing. Most "stages" last from November to May.

Value of Grants

a) Payment of 75,000 francs a month for the standard period of six months. (This period can be lengthened or shortened if necessary and possible.) This is worth more in purchasing value than $200 a month in Canada;

b) Free return trip from France to Canada by boat in cabin class or by plane in tourist class;

c) Free transportation in France for authorized trips related to the purpose of the scholarship;

d) Privileges normally reserved to university students, to the extent available (lodging and restaurant facilities, community activities, libraries, lectures, etc.). Many Canadian students in Paris live at "Canadian House" in the "Cité Universitaire"

e) An allowance of 20,000 francs for the purchase of technical books and of 3,000 francs for the cost of typing a final report on the "stage";

f) "Social Security" benefits covering a large part of expenditures in case of illness.

Qualifications of Candidates

a) The candidate must hold, or expect to receive next Spring, an engineering degree from a university or institution of high standing, or he must have an equivalent training;

b) He must have had some field experience in his specialty for *at least* one year, obtained after graduation or through employment during summer vacations;

c) He must possess a sufficient knowledge of French. Arrangements can be made to improve his fluency during the earlier part of his stay in France;

d) He must have good references regarding his academic and professional ability, his general standing and his health;

e) He must propose a precise program for his "stage" in France and be able to carry it out profitably;

f) If he is already working, he must obtain a written leave of absence from his employer. He can continue to receive a salary from the latter, but must devote his time and energy to his "stage" program.

Selection of Candidates

The selection is made by the Commercial Counsellors of the French Embassy, assisted by a panel of French engineers and scientists residing in Canada and called the "Comité France-Technique". A candidate who has been chosen in Canada has a very good chance of being accepted by the Service de Coopération Technique in France, provided it proves feasible to make the material arrangements for carrying out the proposed program.

Prompt Action Suggested

Before filing a formal application, which must be made on an official form and accompanied by several detailed documents, a simplified procedure is suggested, namely, that you *write immediately a letter covering as briefly as possible the following points:*

(1) Name, address and telephone number. (2) Date and place of birth. (3) Academic training or equivalent (specify degree and specialty. (4) Practical experience. (5) References (give name and telephone number of two persons). (6) Knowledge of French. (7) Program and duration of proposed "stage" in France. *This letter should be addressed in triplicate to:*

Mr. Raymond Treuil, Chairman of the Comité France-Technique, c/o French Embassy, 464 Wilbrod Street, Ottawa, Ontario.

Annual General and Professional Meeting of the Engineering Institute of Canada

Quebec City, Quebec

Chateau Frontenac

May 21, 22, 23 1958

EVERY MEMBER is invited, and expected.

THE TECHNICAL PROGRAM is in an advanced stage of preparation, with a varied list of subjects to be treated by the engineers who have been directing the projects that have commanded attention lately.

Some of the subjects are: the Deas Island tunnel; highway research and construction; controls for underground excavations; processing of Ilmenite ores; control system of the CF-105 aircraft; vertical take-off aircraft; the International Geophysical Year; earth satellites and rockets; the Baie Comeau plant of Canadian British Aluminum Company; use of electronic computers; thermal power generation; underground power stations; the Quebec-Labrador radio system.

Developments in Quebec will receive special attention, with nine papers devoted to engineering achievements in the province. Some of these will be presented in the French language.

THE GREAT CHARM and historical interest of Quebec City are already famous. This is the opportunity to make a long intended trip to Quebec, or a return visit. The Quebec hosts are always ready with a gracious welcome. Monsieur Bonhomme, the living spirit of the Quebec Carnival, will put in an appearance, even though the carnival will have been finished.

THE LADIES are welcome, as always, and will be provided with an interesting program of their own.

MORE COMPLETE INFORMATION will be published in the April issue. Advance notices and registration forms will be mailed to members during March. Meanwhile, members who will be travelling great distances are urged to make train and plane reservations early.

The Engineering Institute of Canada and The Provincial Associations of Professional Engineers

Editor's Note

This reprint tells the story of the development of registration in Canada from 1896 up to 1943 and of the Institute's responsibility for it, as well as the continuing efforts of the Institute to keep the associations and itself close together in their expanding activities.

This is a documented and authenticated history. It is not coloured in any way by prejudices, misinformation, or misunderstanding. You will see as you read that the statements are documented by references to reports and documents appearing in *The Engineering Journal*, or to reports which are on file in the library.

In these days when much thought is being given to Confederation, perusal of this document should be helpful. A person will be better able to reach a decision on the present situation if he has a knowledge of this background.

This report was first published in *The Engineering Journal* in October 1943.

Foreword

During the past ten years notable progress has been made in clarifying the position and functions of the various provincial associations of professional engineers, in relation to each other and to The Engineering Institute of Canada—the body to which the associations owe their inception and much of their development.

All members of the engineering profession in Canada are naturally concerned with the inter-relation of the activities of our various professional and technical organizations. The present situation is sufficiently complicated. Among distinctively technical societies we have, to begin with, The Engineering Institute of Canada, a Dominion-wide Canadian organization, which includes engineers of all branches of the profession. Another Dominion-wide organization, the Canadian Institute of Mining and Metallurgy, ably represents the mining industry as well as the professional mining engineer. Further, there are in Canada a number of active branches or sections of American engineering societies which deal with specific subdivisions of engineering work. Their members naturally look to the United States rather than to Canadian sources for technical guidance.

With aims distinct from those of the voluntary bodies just named, eight provincial associations of professional engineers have been created to deal with questions regarding the licensing of engineers and the protection of the public against incompetent practitioners. Membership in them, in most cases, is compulsory, their activities are regulated by provincial enactments, and they now exist in all the provinces of the Dominion except Prince Edward Island.

The difficulties arising from this complex structure have, for many years, received consideration from the Council of The Engineering Institute, and there has developed a general desire for progress towards an ideal condition in which the activities and requirements of all these bodies will be mutually co-ordinated. Many have expressed the hope that eventually engineers will not be faced with the necessity of belonging (and contributing) to a multiplicity of entirely independent organizations.

The recent conclusion of agreements between the Institute and four of the Associations, providing for joint membership and a considerable measure of co-operation, gives a fitting opportunity to present the following record of the events which have led up to this desirable achievement, and the activities of the Institute regarding them.

In its present form the account is due to the kindness of S. G. Porter, who was president of the Institute in 1931 and vice-president of the Association of Professional Engineers of Alberta, in 1923. Much of it is based on material which has already appeared in *The Engineering Journal*.

Professional Organization Begins in Canada

The first movement towards the formation of an engineering society in Canada appears to have been set on foot before Confederation by Sandford Fleming, who, with other prominent engineers, endeavoured to interest members of the profession in the advantages of such an association. The regulation of professional activities, as well as the dissemination of professional knowledge, was desired by the men who sponsored these early efforts. It was not until considerable engineering development had taken place in the west, that conditions enabled a society to be organized with success.

An early attempt at the legal regulation of civil engineers in Ontario was made in February 1881, when "an act respecting civil engineers" was introduced in the Legislative

Assembly of that province. However, the bill did not commend itself to the Legislature, or, indeed, to all of the engineers named in it, and it never became law.

Formation and Growth of the Canadian Society of Civil Engineers

About this time, the authorities of Toronto and McGill Universities realized the importance of having educational facilities for training engineers, and the advantages of having an association with which to cooperate, if such could be formed. Further, Montreal, Toronto and Ottawa were the cities most frequented by the profession, and conditions suitable for the formation of a society were gradually developing at these places.

During this period the idea of a Canadian engineering society was in the minds of many members of the profession, and the scheme was thoroughly canvassed both in Ontario and Quebec. Among the men who were active in this matter, and who later became officers or prominent members of the society they were proposing to form, may be mentioned Alan MacDougall, C. E. W. Dodwell, T. C. Keefer, Sir Sandford Fleming, J. L. P. O'Hanly, S. Keefer, Frank Shanly and Kivas Tully. As a result, meetings took place in Toronto, Ottawa and Montreal. Perhaps the most important of these was that held in Montreal on the fourth of March, 1886, of which the manuscript minutes have been preserved. Alan MacDougall was in the chair, and P. W. St. George acted as secretary. On the motion of H. D. Lumsden, seconded by P. A. Peterson, it was resolved that

> "A Society of engineers in Canada be formed, comprising *all branches of engineers*, and that a committee be appointed to meet the other committees of engineers from other cities and then to arrange and form a preliminary constitution, which . . . shall be sent around to those gentlemen who send in their names as being willing to form such a Society . . ."

A similar local committee had been acting in Toronto and also appointed delegates to confer with those from Ottawa and Montreal.

Discussions continued until a provisional committee was chosen. At its meeting on December 9th, 1886, it was decided to call the proposed society the Canadian Society of Civil Engineers, and to send out a circular regarding membership, together with a copy of the constitution proposed for the new body. Applications for membership were numerous, the Society was formed, and a charter of incorporation was applied for in due course. That charter received Royal sanction on June 23, 1887.

The objects of the Society, as set forth in its Act of Incorporation were "to facilitate the acquirement and interchange of professional knowledge among its members, and more particularly to promote the acquisition of that species of knowledge which has special reference to the profession of civil engineering . . ." The Society was also given power to make regulations and by-laws "including all rules that may be deemed necessary for the maintenance of the honour and dignity of the profession." These aims, as defined and expanded in the by-laws, have remained unchanged to the present day.

The by-laws of the Society made it clear that the term 'civil' engineering, used in the Act, had reference to all types of engineering activity other than military.

It should be remembered that in 1887 mechanical, chemical, mining, electrical and other specialized branches of engineering as we now know them, were only in process of development in Canada. It was, therefore, natural that most of the early members of the new organization should be men engaged in railway surveys or construction, in contracting for public works, or in municipal or governmental service. The founders of the new body could not possibly foresee the extent of future development of all branches of engineering work in Canada, but they saw the trend and, accordingly it was provided that its membership should include every branch of the profession.

In drawing up these by-laws it was realized that the membership of such a Dominion-wide body would necessarily be scattered geographically, so that a decentralized type of organization was adopted. For this purpose the formation of local branches was authorized; later, geographical districts and provincial zones were provided for. The first branch was formed in Toronto in 1890; the second in Cape Breton in 1905. By 1912 branches had been formed in Quebec, Winnipeg, Ottawa, Vancouver, Kingston, and Victoria, and others followed as opportunity occurred, until to-day there are twenty-five, located in the principal cities of the Dominion from Sydney, Cape Breton, to Victoria, Vancouver Island. These branch organizations perform an indispensable function, giving the Institute, as it now exists, a local habitation in every important centre, and stimulating there an appreciation of the engineer and his work, both in a personal and a professional sense.

Growth in numbers was accompanied by a corresponding increase in the diversity of the branches of engineering followed by the members. This soon resulted in the formation of four sections, general, electrical, mechanical and mining. After about ten years of the Society's existence it was felt that the term 'civil' engineering had come to be generally used in a much more restricted sense than that in which it had been employed at the time of the Society's foundation; this feeling was later to be one of the motives leading to a change in the Society's name and the extension of its activities.

Among the members there were always many who felt that in addition to promoting the dissemination of professional knowledge, the new body should take steps to enable the public to distinguish between qualified and unqualified engineers. At the Annual Meeting of 1896 a committee was appointed to consider the question of professional status. In consultation with provincial subcommittees a draft act of provincial incorporation of the Society was prepared, which, with some modifications, became law in Manitoba in 1896, and in Quebec in 1898, limiting the practice of 'civil' engineering to the members. These enactments, however, did not prove satisfactory in operation, and further legislation was not attempted at that time. But it was then realized that provincial (not federal) legislation had to be secured, the protection of the public, as provided in the British North America Act, being essentially a provincial, not a federal responsibility.

First Canadian engineering society was formed in 1887 and formation of local branches was authorized.

The Can. Soc. C. E. Becomes The Engineering Institute of Canada

During nearly thirty years of healthy growth of the Society, Canada's industrial development and the accompanying tendency towards greater specialization in the profession made it evident that some changes in organization were desirable to increase and extend the Society's usefulness.

Accordingly, a Committee on Society Affairs was formed; its report, presented to the Council in October, 1917, proposed a revision of the by-laws and recommended that the name of the Society be changed to "The Engineering Institute of Canada" as being more expressive of the functions which the organization was performing. This revision was approved, and by Dominion Act of April 15, 1918, the Canadian Society of Civil Engineers became "The Engineering Institute of Canada."

Under its new and comprehensive charter, the national organization of the profession was further developed. A permanent secretariat was provided and, in 1918, the *Journal* of the Institute was established.

The First Professional Meeting of the Institute was held in Toronto on March 26-28, 1918. Mr. H. H. Vaughan, in his presidential message, pointed out that "The change in name implies the attempt to unite all engineers in Canada, to whatever branch of the profession they may belong, into one society."

The Institute Approves a 'Model Act'

At the Second General Professional Meeting of the Institute, which was held in Saskatoon, on August 10, 1918, a paper was read by Mr. F. H. Peters, which drew attention to the benefits to be derived by the profession through legal enactments regulating professional practice, discussion of this matter having been introduced by a resolution passed by the Calgary Branch during the summer of 1917. It will be recalled that at this time there was in force in the province of Quebec an act respecting the practice of engineering passed in 1898, and revised in 1900, and in the Province of Manitoba an act passed in the year 1896, incorporating the Canadian Society of Civil Engineers in that province.

The sentiment throughout the profession that the engineer would benefit by the legal establishment of his professional rights found further expression at the Institute's Annual Meeting in Ottawa, on February 12, 1919, in the formation of a committee for the purpose of drawing up a Model Act* for submission to the various provincial legislatures. Prompt action followed, and this act served as a basis for legislation which was obtained shortly thereafter, establishing associations of professional engineers in nearly all of the provinces of the Dominion. It is to be noted that no provision was made in the Act to relate these new legal organizations to the Institute in any way.

At its meeting of September 23, 1919, Council approved the proposed legislation, encouraged the Branches and Provincial Divisions to co-operate in the promotion of provincial enactments, and gave Council's moral support to this movement. On the ballot which approved the Model Act, seventy per cent of the votes cast by Institute members were in the affirmative.

The Model Act defined the "practice of a Professional Engineer" and described the powers and duties of a provincial association of professional engineers. It covered the admission of candidates to the study and practice of the profession as members of such an association, regulate their government and discipline, and provided that only registered members or licensees of the association could use the title "professional engineer". Suitable provision was made for administration by a president and council, penalties were prescribed for unauthorized practice, and methods of registration and examination were indicated.

The functions of a provincial association under such an act would therefore be to regulate admission to the profession and to administer the provincial law regarding its practice.

In March 1920, Council appointed a committee to report on the question of the remuneration of engineers, a matter very much to the fore in the profession at that time. In fact, reactions in this regard were largely responsible for the great activity in the promotion of provincial enactments which was then manifest.

Associations Established By Provincial Legislation

During 1920 provincial acts based on the Model Act were obtained in British Columbia, Quebec, Manitoba, Alberta, New Brunswick and Nova Scotia. The Ontario Act followed on June 5, 1922.

Thus, by 1923, similar legislation had been obtained in all the provinces except Prince Edward Island and Saskatchewan. An act was obtained in the latter province in 1930.

It should be noted that, in British Columbia, the passing of the act was largely due to the activities of a body formed for that specific purpose, and called the British Columbia Technical Association.

Experience with these enactments soon raised a question as to the definition of the term "professional engineer."**

Further, the acts, though they were all based on the Model Act, were not alike in all their provisions. Thus the legal powers of the various associations differed in degree, and from time to time amendments to several of the acts, tending to emphasize this lack of uniformity, have caused difficulties. On the whole, however, the main lines of the Model Act have proved to have been correctly drawn.

In some cases a tendency developed for the new provincial organizations to function in a manner contrary to the idea which prompted their formation, and certain representations having been received from the west, the Council of the Institute at its meeting in February 1923, unanimously adopted the following resolution:—

"Whereas it is the opinion of the Council of The Engineering Institute of Canada that all technical matters in connection with engi-

Model Act approved 1919 by E.I.C. Council, defining "practice of a Professional Engineer" and describing role of provincial association, led to legislation in seven provinces by 1923.

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*See The Engineering Journal, May, 1919, p. 411.

**See a comprehensive discussion by Mr. A. D. Flinn, of the American Engineering Council in The Engineering Journal 1929, p. 387.

neering should be the function of The Engineering Institute of Canada, and that the various Corporations and Associations of Professional Engineers in the different provinces are, or should be, designed solely for the purpose of administering the provincial laws in connection with legislation;

Be it resolved:—That the Council of The Engineering Institute of Canada go on record as approving the above principle and that all possible steps be taken towards the adoption of this principle;

Be it further resolved:—That the Secretary be instructed to write the various provincial bodies calling their attention to this resolution and asking their co-operation to that end;

Also be it resolved:—That the Council of The Engineering Institute of Canada suggest to each of the various provincial bodies that they send one or more representatives to a meeting for the purpose of discussing the relations of those bodies to The Engineering Institute of Canada, to the end that finally an Act may be enacted similar in principle to the Roddick Medical Bill*.

It is unfortunate that the relations of the Institute (a voluntary body) with the new associations (provincially constituted bodies having compulsory membership), could not be clearly defined from the outset, for it soon became evident that such questions as the duplication of fees and the diversity of standards for admission as between the associations and the Institute, and also between the associations themselves, would have to receive consideration.

The Institute Calls Conference of Association Delegates

On the invitation of the Council of the Institute in December, 1925, a conference of delegates of the provincial professional associations was held at the Institute Headquarters in Montreal in February, 1926, in order to consider this situation and other matters affecting the common interests of the associations. The principal item on the agenda of this meeting was co-operation with The Engineering Institute of Canada. The seven associations then existing were represented and the discussions lasted for three days, the resulting recommendations being submitted in due course to the councils of the several professional associations. Although defraying the expenses of the delegates, the Institute was not represented officially at this conference.

After appointing a corresponding secretary, the delegates left with a resolution recording the sense of close association developed by the conference and their appreciation of the courtesy extended to them by the Institute.

Activities of The Institute Council

At its meeting of January 18, 1927, Council was advised that, in accordance with its instructions, the secretary of the Institute had written to the secretary of the Corporation of Professional Engineers of the Province of Quebec, requesting him to communicate with the governing bodies of the various provincial associations of professional engineers, with a view to discussions as to the best method to be adopted to bring about substantial uniformity in the requirements for admission by examination to the several provincial associations and to the Institute.

In the same year the Institute's Board of Examiners, on instructions from Council, exchanged views with the Boards of Examiners of a number of the professional associations to see what could be done towards obtaining uniformity in examination requirements. No definite progress in this respect seemed possible at that time without meetings for discussion, but in 1928 a revised examination syllabus of the Institute was prepared and communicated to the associations, as a possible basis for further action.

In October, 1927, the First Plenary Meeting of the Council of The Engineering Institute of Canada took place. The afternoon session of October 11th was devoted to a consideration of the policy to be pursued as regards the Institute's relations with the various provincial associations. The necessity of developing uniform admission examination requirements was stressed and it was resolved "that a standing committee representative of all the interested provinces of the Dominion of Canada be appointed by the Council of The Engineering Institute to study the problems involved in co-ordinating the activities of The Engineering Institute of Canada and the several associations of professional engineers." This committee was called the Committee on Relations of the Institute with the Professional Associations, and its personnel was named at the Council meeting of November 25, 1927.** It consisted of Institute members from all the provinces.

Work of The Institute's Committee on Relations

The Committee was unable to commence work for some time and made no report at the annual meeting of February 1928. In June of that year Mr. George McLeod, the chairman, was compelled to resign through pressure of other work and Mr. S. G. Porter was appointed chairman.

The Second Plenary Meeting of Council was held in Montreal on October 15, 16 and 17, 1928. At this meeting the chairman of the Committee on Relations was able to present an interim report which stated that this committee was studying the following questions:—

> "1. Considering the welfare of the profession in its broadest sense, what relationship should exist between The Engineering Institute of Canada and the various provincial associations?
>
> 2. What obstacles are there in the way of attaining the desired end?
>
> 3. What procedure do you suggest for overcoming them?"

While the Committee was not yet in a position to make a definite recommendation, it appeared that many of its members believed that the ultimate integration of all the provincial professional organizations was attainable, but the Committee had not been able to define the action which in its opinion The Engineering Institute should take in this movement.

The Committee was continued under the chairmanship of Mr. Porter to report at the next plenary meeting of Council; discussion brought out the suggestion that the provincial associations might possibly function as provincial divisions of the Institute.

At the meeting of Council on January 22, 1929, upon the request of the chairman of the Committee on Relations, the secretary was directed to communicate with the council of each of the provincial associations suggesting the appointment of provincial committees to co-operate with the committee of the Engineering In-

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*Which provided for Dominion-wide medical registration and qualification.

**See The Engineering Journal, November 1927, page 497.

stitute. In its report for the year 1928, Council indicated "that some progress had been made towards the establishment of a more uniform standard of requirements for admission to these bodies (professional associations) and to the Institute, whether by examination or otherwise."

The Committee on Relations made a report to the annual meeting in February, 1929, indicating that this Committee was in active correspondence with members of the provincial associations and stating—"it is felt that events are tending towards the amalgamation of the various provincial associations into some kind of Dominion-wide organization, and that the time is now opportune for the Engineering Institute to offer the benefit of its organization and the machinery to bring all these organizations together . . . The sentiment for consolidation with the Engineering Institute is favourable among a large body of members of the provincial associations."

In March, 1929, Council appointed a Committee on Policy, under the chairmanship of Dr. O. O. Lefebvre, to investigate and make recommendations as to such changes as seemed desirable in respect of the present classes of membership in the Institute, its organization, publications, and general policy.

At its meeting of September 10, 1929, on the suggestion of Mr. Porter, Council decided to invite a representative from each provincial association, who was also a member of the Institute's Committee on Relations, to take part in a meeting of that Committee to be held at Headquarters on October 5, 1929, just previous to the coming plenary meeting of Council.

The Third Plenary Meeting of Council was held in Montreal on October 7, 8 and 9, 1929. To this meeting Mr. S. G. Porter presented the report of the Committee on Relations, which was unanimously adopted by the Council. On the motion of Dr. Lefebvre it was unanimously resolved:

> "That the secretary renew the invitation sent to each of the provincial associations in February 1929, requesting them to co-operate with The Engineering Institute of Canada, and sending them a copy of the report of Mr. Porter's committee, with the statement that the Council of the Institute had adopted the recommendations contained therein."

This report of the Committee on Relations was presented at the Annual Meeting of February 12, 1930, and after considerable discussion was adopted, one member dissenting. It dealt with uniformity of requirements for admission; reciprocal registration arrangements; advantages of a national organization to represent the whole profession, especially in connection with legislation and public welfare; and the increased ability to promote the educational function of the profession. Its recommendations were as follows:

1. That this Committee or a similar one be continued.
2. That at least one member of Council in each province be added to the Committee to act during his term of office in all cases where Council is not already represented.
3. That this committee be authorized to appoint a small sub-committee whose duty it shall be to approach the provincial associations and in conjunction with them devise a detailed proposal to bring about a co-ordination of the interests and activities of the various provincial associations and The Engineering Institute of Canada; and further, it is recommended that a sum of $1,800 be appropriated towards a fund to provide for the expense of this work.
4. That The Engineering Institute of Canada, through the *Journal* and otherwise, continue to encourage and support the activities of the provincial associations, and contribute in every reasonable way to their success.
5. That immediate steps be taken to arrive at an agreement among the professional associations, and the Institute, for the adoption of standard uniform requirements for admission to membership, and that these requirements be rigidly adhered to.
6. That upon the acceptance of such standard requirements, the Institute should adopt the policy of accepting membership in a professional association as sufficient evidence of qualifications for admission to The Engineering Institute of Canada.
7. That steps be taken to secure the necessary amendments to the by-laws so that membership or registration in a professional association be one of the requirements for admission to corporate membership in The Engineering Institute of Canada for all applicants residing in a province where an engineering profession act is in effect.

The Committee on Relations was accordingly continued, and at the meeting of Council held on April 11, 1930, Past-President H. H. Vaughan was appointed chairman in succession to Mr. Porter, and a sub-committee was appointed in accordance with recommendation No. 3 to approach the provincial associations.

At this meeting the Council was informed that the Professional Association of New Brunswick had appointed a committee to consider the question of closer co-operation between the various provincial associations and the Institute.

At this point it is of interest to note that the recommendations of the 1930 report of the Committee on Relations — particularly items 5 and 6— contained provisions which were very similar to those of the agreements now in force or pending between some of the professional associations and the Institute.

A National Committee Proposed by Institute

At the Fourth Plenary Meeting of Council, held in September, 1930. Mr. Vaughan presented a further report from the Committee on Relations, which recommended that a study of the possibilities in the matter should be made by a national committee nominated by all of the provincial associations and the Engineering Institute. This national committee would be asked to make an analysis and comparison of the various provincial acts and requirements for admission, which it was hoped would lead to the working out of a draft set of by-laws and requirements for membership that could apply to all the provincial associations and to The Engineering Institute of Canada. This work of analysis and drafting was to be done by a sub-committee of three (afterwards changed to four) members of the National Committee, representing the Maritime Provinces, Quebec and Ontario, the Prairie Provinces, and British Columbia respectively. It was thought that when such a draft had been prepared and had been criticized by all members of the National Committee it might then be submitted to the councils of the associations and of The Engineering Institute of Canada for their consideration. This proposal was at once approved by the Institute's Council.

At the Institute's Annual Meeting

in February, 1931, the Committee on Relations reported* that the proposals for a National Committee were under consideration by the governing bodies of the professional associations, and that some of these had already approved of the suggestion and had appointed their members on that committee. Ultimately members of the National Committee were appointed by the councils of seven of the eight professional associations, who thus concurred with the course proposed.

Uniformity was sought by E.I.C. and Associations. Report of the Associations' Committee of Four, 1931, gave rise in 1933 to the present Dominion Council of Professional Engineers, E.I.C. offering co-operation.

At this point, however, the council of one of the provincial associations maintained that co-ordination of all activities of engineering associations throughout Canada might be obtained more readily by developing a plan which would at first apply only to the provincial associations. Definite objection was made to any plan which would at once include The Engineering Institute of Canada. Further, the council in question was unable to approve of the proposed Committee of Four unless its members were accredited by the associations alone, the Institute taking no further active part for the time being.

After due consideration, the president of the Institute and the chairman of its Committee on Relations felt it necessary to allow this objection, and consequently the matter rested at this stage, awaiting further action by the associations. Meanwhile the Council of the Institute again further expressed its desire to co-operate with the associations in furthering the best interests of the profession throughout Canada.

Associations Alone Establish Committee of Four

The Committee of Four—all representatives of the provincial associations—was convened in Montreal, August 24, 1931. The members of this committee were:

J. M. Robertson, M.E.I.C., representing Ontario and Quebec.

C. C. Kirby, M.E.I.C., representing New Brunswick and Nova Scotia.

R. S. L. Wilson, M.E.I.C., representing Manitoba, Saskatchewan and Alberta.

A. S. Gentles, M.E.I.C., representing British Columbia.

Their report, which was made to the councils of the professional associations, was dated September 4, 1931, and contained recommendations which ultimately gave rise to the present Dominion Council of Professional Engineers.

The opinion of this committee was that "a Dominion-wide body representing the entire engineering profession and embracing all of its activities is a practical ultimate possibility . . ."

The objective of such a body would be "the co-ordination of all activities permissible under the provisions of the British North America Act."

Thus, in 1931, the professional associations and the Engineering Institute were agreed on the fundamentals of such co-ordination, but it has taken a further ten years to work out details of any practical working agreement.

The Fifth Plenary Meeting of Council was held in Montreal on September 21, 22 and 23, 1931. At this meeting the report of the Committee on Relations was received which outlined the formation and policy of the Committee of Four of the provincial associations, and stated that to meet the views of the British Columbia Association the Institute had officially withdrawn from deliberations on co-ordination for the time being. The Institute, however, was ready to co-operate in every possible way to promote the work of the Committee of Four.

The Committee of Four reported on September 4 to the professional associations and recommended the formation of a larger body, the "Dominion Council of the Engineering Profession" composed entirely of representatives of the professional associations.

At the Annual Meeting of February 1932, the Institute approved the action of the plenary meeting with reference to the activities of the Committee of Four of the professional associations.

There was little activity in professional engineering legislation in 1932, except that the Ontario Association endeavoured to get an amendment to their act so as to prevent the practice of professional engineering by unregistered persons. Their original act merely prevented the unauthorized use of the title "Professional Engineer". The act in British Columbia had been amended along these lines in 1930.

Dominion Council Formed by Associations

The provincial professional associations, having appointed representatives to a "Dominion Council of the Engineering Profession" as recommended by the Committee of Four, this Council, beginning as a "Committee of Eight," met in Montreal on February 1, 1933, and issued a report under date of February 4, in which it stated, "We believe that there is every reason to expect that the ultimate outcome of such studies will be the complete co-ordination of all activities of the engineering profession in Canada." A proposed constitution for the Dominion Council was drawn up and included in the report. The Committee of Eight held no further meetings, its work having been continued by the Dominion Council.

Institute Shows Continued Interest

The Maritime Professional Meeting of the Institute which was held at White Point Beach, Nova Scotia, in July 1933 was noteworthy as being the first professional meeting of the Institute to be held with the active co-operation and support of one of the provincial associations of professional engineers. It was in fact a joint undertaking. Some of the sessions were those of a Maritime General Professional Meeting of the Institute; a portion of the time was devoted to a General Meeting of the Association of Professional Engineers of Nova Scotia. The great majority of engineers attending were members of both organizations, so that this arrangement presented no difficulty. It gave an effective demonstration of the way in which the educative and technical work of the Institute could be carried on in conjunction with the official duties of a professional association.

Representatives of all the four Maritime Branches of the Institute

*See The Engineering Journal, February 1931, p. 102.

were present, as well as members of the Association of Professional Engineers of New Brunswick. The onerous work of preparation for the meeting was actually performed by a joint committee composed of members of the Halifax Branch of the Institute and members of the Association of Professional Engineers of Nova Scotia.

The Sixth Plenary Meeting of Council was held in Montreal on October 30, 31 and November 1, 1933. It considered in detail the proposals of a Committee on Development which had been appointed in November 1931 to review the constitution and aims of the Institute. After discussion, the proposals were approved for submission at the annual meeting and subsequent ballot by the membership. The Council placed on record its desire to co-operate in every way with the provincial associations of professional engineers and it was resolved that the Institute should take every opportunity to collaborate with the provincial associations, particularly in endeavouring to secure a generally acceptable uniform scheme of registration of engineers in all parts of the Dominion.

At the Annual Meeting of the Institute held in Montreal on February 8, 1934, the final report of the Committee on Development, as expressed in a proposed revision of the by-laws of the Institute, was received and caused considerable discussion. It was pointed out that the wording of some of these by-laws would be affected by the policy to be followed regarding closer relationships with the provincial associations, and the suggestion was put forward that it might be wise to forego sending these by-laws out to a ballot of the general membership until further efforts had been made toward closer co-operation between the Institute and the professional associations, which might modify to a considerable extent some of the by-laws proposed. It was found, however, that the regulations of the Institute would not permit this delay. When the ballot was taken, the proposed amendments failed to carry.

At the meeting of Council of June 5, 1934, a proposal was presented for renewed action by the Institute, looking toward the co-ordination of the profession in Canada, but consideration of this matter was postponed until the fall. This Council meeting decided that the subject for the Past-Presidents' Prize for the year 1934-35 should be, "The Co-ordination of the Activities of the Various Engineering Organizations in Canada."

Institute Branches Request Further Action

During 1934 Council received a number of communications making suggestions regarding co-operation with the associations. In October, the Halifax Branch forwarded a resolution to Council favouring the consolidation of the profession in each province and throughout the Dominion.

At its meeting of November 16, Council received a communication from the Vancouver Branch dealing with the future policy and lines of development of the Institute. At this meeting the Council approved certain amendments to the Winnipeg Branch by-laws, which were calculated to facilitate the co-operation of that branch with the Association of Professional Engineers of Manitoba. This meeting of Council also discussed a suggestion from the president of the Association of Professional Engineers of Alberta, that the Institute might act as a clearing house in communications between the associations of professional engineers and the Department of Immigration with regard to applications for admission of foreign engineers to Canada. The suggestion was approved, provided the consent of all professional associations to the arrangement could be secured.

The Montreal Branch, at its Annual Meeting of January 10, 1935, discussed the question of consolidation, and at a further meeting of January 30, forwarded to the Council for presentation at the annual meeting, a resolution similar to that of the Halifax Branch.

Consolidation was chief business of annual meetings of 1935 and 1936. Committee on Consolidation was formed to establish closer relations with eight provincial associations.

Work of The Institute Committee on Consolidation

At the Annual General Meeting of the Institute held in Toronto on February 7, 1935, the above resolutions, together with resolutions from the Ottawa Branch, the executive committee of the Quebec Branch, the executive committee of the Border Cities Branch, the Lethbridge Branch and the Association of Professional Engineers of the Province of New Brunswick, were presented, and thus the question of consolidation became the chief business of the meeting. As a result, a Committee on Consolidation was formed, under the chairmanship of Gordon MacL. Pitts, "to develop the possibilities of consolidation of the engineering profession in Canada." This committee was instructed to report its findings through Council to a general meeting of the Institute.

Thus the Committee on Consolidation had necessarily as its principal object the establishment of closer relations with the eight provincial associations of professional engineers, as a first step towards the organization of the engineering profession in Canada on a truly national basis.

It was obvious that the diversity of the interests concerned made the problem difficult of solution. While there are a large number of Canadian engineers who actively support the registration movement by belonging to the associations, there are many who do not do so. Some of the corporate members of the Institute are not registered. As regards non-members of the Institute, some belong to no organization at all, some belong to a professional association, and others have joined non-Canadian engineering bodies.

There seemed to be at least two main schools of thought on this question. On the one hand there was the view that everyone should be registered who is engaged in any kind of engineering work requiring professional training as distinguished from the work of a foreman or skilled craftsman. On the other hand some believed that legal registration as a professional engineer should be required only of those whose work makes them personally responsible for the protection of the public. A totally different doctrine was held by those few who did not believe in registration, and were of the opinion that legal authorization to practice is unnecessary for any engineer, either in his own interest or that of the public.

Any scheme for the better organization of the profession which can commend itself to all, or even a majority, of the holders of these divergent opinions must evidently contain features on which some compromise has been made. In fact, both the engineers whose main interest lies with the legal work of the associations, and those who attach more importance to the technical and educational work of the Institute, would have to give some effective recognition to their opponents' views before any workable plan could be evolved.

In regard to this matter, the attitude of the Council of the Institute has been consistent ever since 1919, when it gave approval to the proposed provincial legislation based on the Model Act prepared by an Institute committee. It is true that at that time no attempt was made to relate the new legal organizations to the Institute, and, in the light of later events this was perhaps unfortunate. It would seem that if the legal and other difficulties involved in forming such a relation had been faced at that time, more rapid progress would have been possible.

The Institute Council, however, has constantly endeavoured to promote closer relations with the provincial associations and thus bring about a measure of unity in the profession in Canada. The history of these efforts was summarized in the report* of the Committee on Consolidation which its chairman presented at the Annual Meeting of 1936.

In this report, prepared after a year of strenuous work, the committee put forward a series of proposals for the amendment of the Institute by-laws, defining the lines along which, in the committee's opinion, the Institute could best co-operate with the associations.

The principal features of the proposals were, the recognition by the Institute of membership in the associations as a qualification for membership, the establishment of a standing committee to be known as the Committee on Association Affairs, representation of the associations on the Institute Council, the abandonment of the grade of Associate Member in the Institute; associations which co-operated with the Institute would be known as Component Associations. In a province where a Component Association existed, membership in that association would in future be essential for admission to the Institute.

After preliminary discussion at the annual general meeting of 1936, these proposals, and in fact the whole relations of the Institute with the professional associations, were the main subjects of debate at the Seventh Plenary Meeting of Council held in Montreal October 1936.

At that meeting the proposals of the committee underwent some modifications before being approved by Council for submission to the next annual meeting and, if then accepted, for ballot of the membership as required by the by-laws.

During the discussion, Mr. C. C. Kirby, president of the Dominion Council of Professional Engineers, said that he believed the desires of the majority of engineers in Canada were: —

(a) Closer co-operation between the provincial associations;
(b) Some form of alliance with a national body organized so as to avoid the present duplication of fees; and
(c) The national body to be representative of the whole engineering profession.

The idea of creating a new body to implement (a) and (c) was acceptable in some provinces, but unacceptable in others, because the Institute with its history of service to the profession was available. The provinces themselves were not unanimous on the registration movement, and some engineers now members of the Institute were not required by the nature of their employment to become registered. The idea that the associations should also maintain permanently their own Dominion Council had proved unacceptable to some associations. He believed that the proposals of the Committee on Consolidation appeared a practical compromise between all these views.

Mr. Kirby presented a suggestion from British Columbia that all associations should have representation on the Council of the Institute in proportion to the number of their members, provision also being made for accredited substitutes with proxy rights.

Mr. Kirby did not think that such a proposal had ever been made in connection with the Dominion Council, and said that under the committee's proposals every member of an association would be represented on the Institute Council by his own association's appointee.

There was no intention or possibility of transferring any powers legally belonging to the associations to the Institute or its standing committee.

The proposals of the Committee on Consolidation were duly discussed at the Annual General Meeting in January, 1937, and the proposed revisions to the by-laws were sent forward to ballot by the membership. A difference of opinion between Council and the Committee on Consolidation led to the submission of an alternative proposal by Council in respect to one section of the proposed amendments.

The proposals submitted to the membership were intended to be a compromise to safeguard the interests of all members of the Institute. It was also hoped that the proposals would enable the professional associations to unite in co-operating with the Institute. Such co-operation would make it possible ultimately to build up a Dominion-wide organization which would represent the profession as a whole.

In this connection it must be remembered that apart from the Institute and the professional associations, there exist in Canada a number of important technical societies, some of which are branches of non-Canadian organizations, whose ultimate co-operation would be essential for the full development of the organization movement. As yet it had not been feasible to consult officially with these bodies, since it was first necessary to find a solution for the problem of co-operation with and between the professional associations.

When the ballot was taken in April 1937, however, there was a substantial majority against the amendments which embodied the proposals of the Committee on Consolidation. It seemed evident, however, from the many discussions which had taken place, that most Institute members, while objecting to certain details of this particular scheme, were, nevertheless, sincere supporters of the principle of co-operation between the Institute and the associations.

Discussions with some Associations Begin

Following the announcement of the results of this ballot, the subject of the Institute's relations with the associations came up at practically every Council meeting during the year. It soon appeared that in certain provinces, particularly Nova Scotia, New Brunswick, Manitoba,

*See The Engineering Journal, January 1936, pp. 35-39.

Saskatchewan and Alberta, the problem of co-operation might be regarded as comparatively simple. In these instances the number of members involved is not large, and it was felt that working arrangements could be established with some of these bodies if the Council were authorized to enter into agreements with the associations concerned. But as regards the three other associations, the situation seemed different. Their membership is larger and contains a greater proportion of association members who are not in the Institute. There are also a considerable number of members of the Institute who do not belong to those associations. For these and other reasons, the desirable objects, such as common membership, or uniform standards of admission as between the associations themselves and with the Institute, are more difficult of attainment in these cases.

In fact, at its meeting in May 1937, Council was informed that a local committee in Nova Scotia was studying the possibilities of co-operation there between the Institute and the Professional Association. Discussions along similar lines were taking place in Saskatchewan and Manitoba. The president reported in regard to a visit to Winnipeg, which he had made at the request of Council to meet the members of the Winnipeg Branch and the members of the Manitoba Professional Association. He outlined the proposals for co-operation between the Institute and the Association in Winnipeg which had been under consideration there. It was reported that the Council of the Association of Professional Engineers of New Brunswick was also considering the matter. In compliance with a suggestion from Halifax, Professor H. W. McKiel and Mr. C. A. Fowler were appointed to represent the Institute Council in the Nova Scotia discussions.

The Council Forms Committee on Professional Interests

The Eighth Plenary Meeting of Council was held in June, 1937. At this meeting, Council discussed the relations of the Institute with the professional associations in Nova Scotia, New Brunswick, Manitoba and Saskatchewan, and a resolution was unanimously passed expressing Council's desire to co-operate with all the associations. After discussion, it was decided to appoint a Committee on Professional Interests under the chairmanship of Past-President F. A. Gaby, with Past-President O. O. Lefebvre and Councillor F. Newell as members. Its duty would be to deal *inter alia* with matters involving negotiations with the professional associations, without prejudice, however, to the negotiations in Nova Scotia, and working with the aid of provincial sub-committees.

In October 1937 a number of proposals for the amendment of the Institute by-laws were received from thirty-one corporate members for submission to Council. These were based on some of the important provisions submitted by the Committee of Consolidation in 1936. They proposed the retention of the class of Associate Member; the automatic admission of corporate members of the professional associations, subject to classification by Council; the establishment of Component Associations, and of a Committee on Association Affairs; the payment by a Component Association annually to the Institute of a fee of 50 cents for each member of a Component Association licensed to practise; the payment by a Component Association whose corporate members are admitted as members of the Institute of a *per capita* annual fee to be determined by the Council, which would include the *per capita* fee of 50 cents referred to, and an annual subscription to the *Journal;* the recognition of a new class of non-corporate membership to be called "Provincial Associates" which would comprise those members of an association who do not become members of the Institute; the compulsory investigation by Council of the conduct of any member who might be expelled from a Component Association; the fixing of the entrance fee of the Institute for all corporate members at $15.00.

At the October meeting of Council, Messrs. McKiel and Fowler attended and presented their report on the situation in Nova Scotia, outlining a scheme for co-operation which had been endorsed by the Council of the Association and by the Institute branches in Nova Scotia. They recommended that Council express its willingness to enter into an agreement with the Association whereby the Institute would accept all members of the Association as corporate members of the Institute, while the Association would collect a single fee from all of its members, covering the annual fee to the Institute, a sum for the operation of the Institute branches in Nova Scotia, and the annual fee to the Association. This arrangement would be conditional on all members of the Association joining the Institute.

After discussion, the scheme was approved in principle, and it was directed that a letter ballot of Council should be taken as to Council's willingness to enter into such an agreement. It was noted that as the proposal would involve a change in the schedule of fees for Nova Scotia members, it would be necessary to obtain an amendment to the by-laws empowering Council to enter into an agreement of this kind.

At the same Council meeting, the proposals of the thirty-one corporate members for the amendment of the Institute by-laws, which had been sent in on October 1st, were submitted for Council's consideration in accordance with Section 75 of the by-laws.

Council was of the opinion that in view of the report just received from Nova Scotia and the activities of the Committee on Professional Interests, it would be desirable to suggest to the representatives of the thirty-one proposers either the withdrawal of their proposals and the substitution of an amendment legalizing Council's action regarding the Nova Scotia agreement, or some modification of their proposals which would bring them more in line with Council's views as developed during the year. With this in mind a committee consisting of the president, Past-President Shearwood, and the presidential nominee, J. B. Challies, was appointed to confer with representatives of the proposers.

In Council's view, the length and apparent complexity of the proposals of the thirty-one members, as well as the retention of many points of similarity with the consolidation proposals which had been so recently rejected on ballot, would make it very difficult to secure their acceptance by vote of the general membership, whereas a briefer and broader proposal would have a much better chance of obtaining the necessary majority. Further, these proposals might tend to confuse the promising negotiations presently in hand with several of the associations.

After discussion, the representatives of the thirty-one proposers felt that, without consulting their principals, they could not undertake to withdraw the proposals. Such consultation would take place as quickly as possible.

At the Council meeting held in November, it was reported that on letter ballot a majority of councillors thought that Council should express willingness to enter into an agreement with the Nova Scotia Association. No negative votes were cast.

A similar request having been received from New Brunswick it was decided to take similar action in that case and to notify our representatives in both provinces of Council's favourable decision in both cases.

In regard to by-law amendment, the president submitted three sections drafted as a compromise and reported that they had not been acceptable to the representatives of the thirty-one proposers. On the other hand, after a full discussion, Council felt unable to accept the new sections put forward by the thirty-one proposers.

New By-Law Enables Council to Negotiate Agreements

The members of Council present then agreed on the draft of a new by-law merely enabling Council to co-operate with any of the professional associations and enter into agreements with them in furtherance of the mutual interests of the members of the Institute and of the associations, and in particular respecting the admission of their members to the Institute and the amount and method of collection of fees. It was directed that this draft should be submitted to all members of Council for approval by letter ballot before being put forward as a definite proposal of Council.

It was the opinion of Council that the situation arising from the rejection of the proposals of the Committee on Consolidation would be met most effectively by this simple by-law, giving Council the power to enter into agreements with the associations. When this was explained to the representatives of the thirty-one corporate members, they accepted the suggested by-law in lieu of their proposals, an action which was appreciated, since it opened the way for immediate action on co-operative agreements with several of the associations.

Accordingly, the proposed new by-law (now Section 78) was presented by Council, and discussed at the Annual Meeting of 1938; it was then accepted for ballot. When voted upon in March, the membership approved it by an overwhelming majority.

Meeting of Dominion Council in Montreal

An event of interest to the Institute as well as to all association members was a meeting of the Dominion Council of Professional Engineers, held in Montreal in April 1938, and attended by representatives of seven of the provincial associations.

The principal business before the meeting was consideration of the differences between the various provincial associations of professional engineers in respect to charters, by-laws and methods of procedure, with special reference to those features governing interprovincial practice.

The Engineering Institute and several associations of Professional Engineers formulated and adopted individual co-operative agreements. The first one was signed in 1938 by the E.I.C. and the Saskatchewan Association.

Discussions With Nova Scotia

In 1938 the first draft* of a proposed agreement between the Institute and the Association of Professional Engineers of Nova Scotia had already been under discussion for some time by accredited representatives of both bodies. After publication in the *Journal* it had been approved almost unanimously by letter ballot of the Institute Council, and by vote of corporate members of the Institute resident in Nova Scotia. Definite action on the part of the Nova Scotia Association did not follow immediately, however, some doubt having arisen as to the Association's legislative authority to complete the agreement in the precise form which had then been negotiated.

Agreement with Saskatchewan Association

During the winter of 1937-38 a committee of the Saskatchewan Branch of the Institute had been studying the possibility of co-operation in that province, and had prepared a draft agreement. The relations of that Branch with the Association of Professional Engineers of Saskatchewan have always been cordial; in fact, it had been the regular practice to hold joint meetings and functions. The executive committees of the Branch and of the Association jointly considered the draft and approved it with minor amendments on April 22, 1938. It was published in the *Journal* in August.** In September it was approved by ballots of the Institute Council, of the Institute's corporate members resident in Saskatchewan, and of the members of the Association. Thus it was possible to arrange for the formal signing in Regina on October 29, 1938, of the first co-operative agreement between The Engineering Institute of Canada and one of the provincial associations of professional engineers.

The president of the Institute, the general secretary and the chairman of the Institute's Committee on Professional Interests journeyed to Regina for this important ceremony. Addresses marking the occasion were delivered by the president of the Institute, Dr. J. B. Challies, and by the president of the Association, Mr. J. W. D. Farrell; the proceedings were broadcast from coast to coast.

The main purposes of this agreement for the co-operation of the two bodies may be stated as:

(a) Common membership in the province of the Institute and the Association,
(b) Simplification of arrangements for the collection of fees,
(c) Reduction in total fees payable by those who are members of both bodies,
(d) Management by a common executive.

Under the Saskatchewan agreement all registered professional engineers in the province, not already members of the Institute, became corporate members without entrance fee. The Association's "Engineers-in-Training" became Juniors of the Institute.

Thus the Saskatchewan Branch of the Institute now consists of all members of the Institute resident in Saskatchewan and all members of the Association.

The Association collects one joint annual subscription from each of its members, from which an agreed sum is paid to the Institute in lieu of its ordinary membership fee.

The officers and council of the Association become the officers and executive committee of the Saskatche-

*Published in The Engineering Journal, March, 1938, p. 247.
**See The Engineering Journal, August 1938, p. 396.

wan Branch and are responsible for its financing and management.

All meetings are announced as meetings of The Engineering Institute of Canada and the Association of Professional Engineers of Saskatchewan.

The tangible results of this agreement, which has now been in operation for five years, are the best evidence of the benefits accruing to the engineering profession in a province by the consummation of such an agreement. During the first year forty-eight members of the Saskatchewan Association, who were not previously members of the Institute. joined the latter body, and thirty-three members of the Institute became members of the Professional Association. In addition fifty-four members of the Association automatically became members of the Institute with the signing of the agreements in 1938.

Agreement with Nova Scotia Association

As regards Nova Scotia, discussions on the draft agreement prepared in 1937-38 continued for some time, while efforts were made to remove or avoid certain technical difficulties. It was not until 1939 that a revised proposal* was ready for submission to ballot. The qualified voters, both of the Association and the Institute, approved it, and it was formally signed in Halifax on January 25, 1940. The Institute was represented at the ceremony by President H. W. McKiel and the general secretary. The president—S. W. Gray—and the registrar signed on behalf of the Association. Thus the seal was set on the result of discussions which had commenced as early as 1934.

The Nova Scotia Agreement, while not identical with the Saskatchewan document, contains many similar provisions. It places the management of the joint affairs of both bodies in the hands of a Joint Finance Committee. A single fee is paid by members to the treasurer of the Association, from which the necessary payments to the Institute and its Nova Scotia branches are made.

Agreement with Alberta Association

By January 1940 the discussions regarding co-operation between the Institute and the Association of Professional Engineers of Alberta had enabled the joint committee—which represented both bodies—to draw up a draft agreement. This draft received the general approval of the Association at its Annual Meeting in March, after similar approval had been given by the Institute Council.

After discussion with the officers of both bodies, and following a conference with two headquarters representatives of the Institute's Committee on Professional Interests who went to Calgary for the purpose, the joint committee completed a final version of the agreement, which, after being accepted by the Council of the Association, was ready in August for formal approval by both bodies. This approval involved the publication of the agreement** and its submission by ballot to the members of the Association and to the members of the Institute.

These ballots were overwhelmingly in favour of the agreement, which was accordingly signed in Calgary on December 14, 1940, by President T. H. Hogg and the general secretary for the Institute, and by President H. J. McLean and the registrar for the Association.

This agreement is generally similar to that with the Saskatchewan Association. As in the case of Nova Scotia, the Alberta Agreement states that to promote close co-operation beween the two bodies, the objects are:

(a) A common membership in the province of the Institute and the Association.

(b) A simplification of the existing arrangements for the collection of fees.

Agreement with New Brunswick Association

In New Brunswick, conferences on co-operation between the Institute and the Professional Association began in 1937, and discussions continued for some time.

As a result a draft agreement was prepared during 1941 following the general lines of those already in force, but with some modifications to meet local conditions.† It was then duly approved by the Institute Council, by the two Institute Branches in New Brunswick, and by an almost unanimous ballot of the members of the Association.

The ceremony of its signature took place in Saint John on the evening of January 12, 1942, at the time of the Annual Meeting of the Association. The signing officers were Vice-President K. M. Cameron and the general secretary of the Institute, together with the president of the Association, G. L. Dickson, and its secretary.

Thus there are now four provinces in which the provincial body and the Institute have come to a working arrangement whereby the benefits of each become available to the other.

Manitoba

Discussions initiated in 1934 have also been proceeding with the Association of Professional Engineers of Manitoba. After some unavoidable delay, a draft‡ was arrived at in 1942 and is now (September 1943) being voted upon by the Association membership and by the Institute membership in Manitoba, having been approved by the Institute Council at its February meeting.

Present Situation

The foregoing review of the various events which have led to the results already achieved, gives some idea of the difficulties which have had to be surmounted in each case by the give-and-take of the representatives of the contracting parties. The situation is complicated, not because of unwillingness or animosity, but largely because of the diversity in the character of the professional engineer's work in the different provinces, the preponderance of one or more branches of engineering in a province, or the association's general policy as determined by industrial or economic conditions in the province concerned.

The cordial relations existing between the Engineering Institute and the Dominion Council brighten the prospect for an eventual solution of the engineering registration problem in Canada. In the Dominion Council the profession has an influential body which can do much to secure the necessary uniformity in the professional requirements and legal regulations obtaining in our different provinces.

In The Engineering Institute of Canada there is available a Dominion-wide organization of recognized standing admitting members of all branches of the profession, and promoting united action as regards technical matters, professional information, and the general welfare of its members.

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*Published in The Engineering Journal, December 1939, p. 534.

**See The Engineering Journal, September 1940, p. 403.

†See The Engineering Journal, November 1941, p. 549.

‡See The Engineering Journal, September 1943, p. 535.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

QUEBEC

New Group Life Insurance Plan

For several years, the Corporation has had a life insurance program for the benefit of its members, thus offering them an opportunity to buy insurance coverage at advantageous rates.

The experience of the group has been most satisfactory. On the other hand, it was felt that some of the features of the original plan could stand improvement. As a result, an investigation was undertaken which culminated in a new plan being adopted by Council at its January meeting. One of the major features of the plan consists of allowing those who might have to leave the Province to retaining their group insurance privileges provided they become and remain members of another provincial Association of Professional Engineers. It will therefore be possible for those people to become legally entitled to practise engineering in the province they go to, and at the same time retain their privileges in the Corporation insurance group without having to remain in the Corporation. It is felt that this feature is in keeping with our common objective to facilitate membership transfers from one association to the other. Otherwise, the new plan is essentially the same as that sponsored by some other provincial Associations.

Montreal Consultant Wins Court Case

A Montreal consulting engineer has recently been awarded damages by the Superior Court in a case which adds to the jurisprudence affecting the work of consultants.

This consultant, retained by a municipality in the Montreal area for the design and supervision of a given project had had his plans finalized and specifications accepted by the municipality, when the latter decided to sever its connection with the consulting engineer, although supervision of the project, for which the consultant was responsible, was to be terminated only several months later.

The municipality paid the fees for services rendered before dismissal, but refused to pay the supervision fees. It claimed that: a) the engineer was to render professional services for a period of indefinite duration; b) the case was not one in which damages were involved; c) the engineer had not experienced any damages; d) the engineer had neglected to offer his services for the supervision.

The Court ruled however, that to all intents and purposes, this case was identical to a case involving an architect and his client, in which the Supreme Court decided that article 1691 of the Civil Code was applicable, and that if "the owner may cancel the contract . . . although the work have been begun . . .", he must indemnify the other party to the contract . . . "for all his actual expenses and labor, and pay damages according to the circumstances of the case."

The engineer testified that in order to carry out his contract with the municipality, he had assigned a two-man team to the job, comprising an engineer and his assistant. The team worked on a part-time basis, and in the meanwhile, carried out other assignments. After the contract was rescinded, it was not possible for the consulting engineer to secure work that would have filled the gap in the activities of the two-man team. The Court therefore felt that the cancellation of the contract has resulted in a loss of fees for the consulting engineer, although his overhead expenses were in no way reduced. In the light of this, the Court ruled that the consulting engineer was entitled to his full fee for the unjustified cancellation of his contract with the municipality.

More Specialization?

by George W. Joly, P.Eng., assistant dean, engineering, McGill University

In its last issue, the *Journal* presented in graphical form, an analysis of the replies to a questionnaire on Professional Training which the Corporation of Professional Engineers of Quebec sent its members in 1956. At that time, members were invited to submit more detailed answers to any questions on which they held strong opinions, and to present other questions which they may have felt should have been raised in the questionnaire. The viewpoints presented by members might be grouped under these headings: a) fundamental science; b) specialized engineering; c) business administration; d) professional attitude; e) humanities.

The replies, none of which touched on all five of these topics, in every case called upon the engineering schools to place more emphasis on these matters in the undergraduate curriculum. What the reaction of an engineering school to this request might be is what is worthwhile examining here.

To demand that more of the fundamentals of science be presented and that more attention be given to specialized engineering practices is to raise the question of what an engineering school does to those men who submit themselves to its discipline. Basically the school imposes a method of thinking on the minds of its students, not a body of facts but primarily a manner of viewing facts. Except if he be the occasional brilliant student, a man who graduates without some habitual way of looking at the data of engineering is not, and will not become an engineer. Now, the student under the influence of the curriculum may adopt a characteristic point of view towards engineering ranging from the purely theoretical to the purely practical. At one end of this spectrum, for there are an infinite number of intermediate positions, a graduate would not be surprised at the strangeness of the engineering problems of 1978 if suddenly he faced them today, but he would not know how to tackle the practical solution even of the problems of 1958. At the other end, a graduate would be shocked at the problems he must face in 1958 although he might be able easily to solve those of 1938.

The creative engineer—which is supposedly the kind every engineer secretly imagines himself to be—if he is to fulfill himself, must be more concerned with today's and tomorrow's theories than with yesterday's practice. The graduates of yesterday will solve yesterday's problems without any help from today's graduates.

It would seem then, if it is creative engineers that are needed for the economy, that any increased emphasis should be placed on fundamental science rather than on specialized training.

Le Chapître de Québec Choisit Les Membres de Son Comité Exécutif

Les membres du premier chapître officiel de la Corporation, fondé à Québec le 6 décembre dernier, ont élu le même jour les membres du comité exécutif du nouveau chapitre. Ce sont les ingénieurs: Roger Desjardins, président, Jacques Roy, vice-président, Lionel Boulet, Marc Cimon, Jean B. Delage, Jean-P. Gourdeau, Jean-Marc Lagacé et Francois L'Anglais, directeurs. La Corporation compte deux autres chapitres, fondés de façon non-officielle il y a quelques années: ceux de Sorel et du Saguenay.

Le président, Monsieur Desjardins,

gradué de Polytechnique en 1939, a été au Service de l'Electrification Rurale de 1939 à 1945; depuis cette date il est ingénieur en charge des Services d'Acqueducs et d'Egoûts à la Régie des Services Publics, Monsieur Desjardins est également chargé de la surveillance du laboratoire thermo-dynamique à la Faculté des Sciences de l'Université Laval.

En plus d'être président du chapitre de la Corporation, Monsieur Desjardins vient d'être élu président de la branche de Québec de l'E.I.C. pour l'année 1958. Le nouveau président du chapitre québecois est capitaine d'Etat Major du 8ième groupe de milice et fait partie d'un comité du Carnaval de Québec, d'un comité de la Fédération des Oeuvres de même que de l'Institut des Services Unis.

ONTARIO

Annual Meeting

The Royal York Hotel, Toronto, was the centre of activity for the Association of Professional Engineers of Ontario on Saturday, February 1, 1958 when members and guests of the 16,000 strong member organization met for the annual meeting and luncheon. Delegates of engineering organizations from other parts of Canada as well as the United States attended the one-day meeting, presenting a review of 1957 and a forecast of the engineering situation during 1958. Official delegates from the provincial areas in attendance were G. S. Halter, Fort William, representing the Lakehead; Harry Sproule, Chatham, representing Kent County; F. Bainbridge, Chalk River; W. S. Taylor, Niagara Falls, representing the Niagara area; and Yorke H. Williamson, Pamour, representing the professional engineers in the Porcupine area.

Elections of the Council of the Association, reported in the February issue of the *Journal*, resulted in the naming of C. T. Carson, vice-president and manager of production for Hiram Walker and Sons Ltd., Walkerville, Ont., as 1958 president of the organization. Mr Carson took over his duties during the meeting from predecessor John H. Fox, 1957 head of the organization.

In his forecast for 1958 the president-elect predicted that the engineering profession in Canada was on the threshold of a new era in which professional recognition and status would be universally achieved. "This year will see a continuation of the great work being carried out by this Association, and there must be no let-up in the program of bringing about an awareness of professional status in the individual engineer and with it realization of the values of professional integrity and responsibility," he said. He felt such a program was bound to bring with it professional recognition on the part of the employer and the general public.

"Realization on the part of the employers of the potential that exists in the young engineer is of the utmost importance. Encouragement of these young men and women by providing an atmosphere that will foster professional growth and the knowledge that they will receive a corresponding monetary return will produce surprising results," Mr. Carson pointed out. There was also an urgent need, he said, for a reappraisal of our teaching methods in high schools to ensure that the engineering subjects, mathematics, chemistry and physics, do not fall by the wayside. Mr. Carson said that there was a danger of this happening and called for an awareness of the present situation on the part of the educational authorities. He urged that special merit be accorded teachers of mathematics and physics who distinguish themselves in carrying out their duties.

In reviewing 1957, Mr. Carson referred to the establishment of a certification program for engineering technicians and technologists as the year's significant achievement.

Luncheon guest speaker Dr. Conrad A. Posz, of Michigan State University in an address entitled, "Why Do We Behave Like People," gave voice to his special skills in the subject of communication in relation to the conveying of thoughts from one human being to another.

Medal Awarded Dr. T. H. Hogg

One of the highlights of the day was the presentation of the highest award of the Association, the coveted Professional Engineers Medal to the late Dr. Thomas H. Hogg of Toronto. Dr. Hogg died three weeks later, on February 24, 1958. Former chairman of the Ontario Hydro-Electric Commission and pioneer of one of the foremost authorities on hydraulic engineering in Canada, he has frequently served in a consulting capacity. The government of Canada, the Province of Ontario, the Province of Manitoba all called upon him. He was, for thirteen years chief hydraulics engineer with the Hydro-Electric Power Commission of Ontario. In 1937 he was named chairman and chief engineer of the organization and held this post until his retirement in 1947. He was president of the E.I.C. in 1940.

Awarded only five times previously the medal is presented for distinguished service and outstanding contribution to the engineering profession. The five previous recipients of the medal are C. D. Howe, former Minister of Trade and Commerce; Dr. C. R. Young, former dean of engineering, University of Toronto; General A. G. L. McNaughton; the late Dr. J. F. Tyrrell, veteran geologist and explorer; and Dr. R. L. Hearn, former chairman of the Ontario Hydro-Electric Commission.

Student Awards

The Gold Medal of the Association was presented to the two engineering students who graduated with the highest standing in 1957 from the University of Toronto and Queen's University. They are John A. Norton of Toronto, and Peter W. McBurney, of Ottawa.

The awards, presented annually by the Association also include a $50.00 cheque to be used by the winners in the purchase of text books. The Association also provides a $500.00 university entrance scholarship awarded alternately at the University of Toronto and at Queen's to the student with the highest academic standing upon entering the faculty of applied science. In addition the A.P.O.E. grants six annual scholarships of $250.00 each, at these universities in first, second and third years.

At morning and afternoon sessions of the meeting reports were heard from the chairmen of some twenty active committees.

BRITISH COLUMBIA

(Taken from an editorial written by George C. Lipsey, president of the Association of Professional Engineers of British Columbia and published in the "B.C. Professional Engineers," January 1958)

Year of Consolidation

After several years of unprecedented peacetime economy in Canada, British Columbia and the rest of North America, signs are appearing which show a distinct levelling off in the economy. It is to be hoped that it is a levelling-off period and that no severe recession will develop. It must be remembered that what goes up must also come down. The cost of carrying on a business enterprise has been increasing more rapidly than the earnings of the enterprise.

This will be a year of retrenchment and consolidation rather than one of continued expansion at an increasing rate, as has been the case for several years. There will be a general shaking down in the industrial life of B.C., and there will be several casualties. This trend will adversely affect the members of the Association of Professional Engineers of British Columbia, but at the same time will challenge the ingenuity and abilities of the engineer. The cost of goods and services will have to be reduced in order that we can compete in world markets. The engineer will be called on during the coming year to get more done for less money and effort, the complete reverse of the challenge of the last several years to complete a job as quickly as possible, regardless of cost. In this period the engineer who can change his methods of thinking and who can draw on past experience will be the most wanted man in industry.

In the period ahead one group of engineers will remain employed but will have to work harder than ever before. Another group will find that there is little demand for their services. The first group can help the second group by remembering the "Golden Rule" and using as many of group two as possible even if the opportunities provided to

(Continued on page 118)

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

William J. Dick, M.E.I.C., prominent in the coal mining industry, first as a mining executive and later as a consultant, a member of the Alberta Power Commission and a director of Inland Cement Company Limited, died on July 3, 1957, at Edmonton.

Born at Nanaimo, B.C., on March 25, 1883, Mr. Dick attended McGill University and was in 1908 awarded a B.Sc. degree in mining engineering. He received a master of science in mining engineering in 1911.

From 1908 to 1910 he worked as a consulting mining engineer for a mining company in Brazil. In 1911 he served as a member of the former Conservation Commission of Canada until 1918. Later at Winnipeg and Calgary he worked as general manager of North American Colleries.

In 1922 Mr. Dick became president and general manager of Cadomin Coal Company of Edmonton, a post which he held until he retired in 1939.

In 1940 he was appointed Western Canada's representative for Allied War Supplies Corporation. Mr. Dick was appointed part-time member of the Workman's Compensation Board in 1941. He became regional oil controller for Alberta in 1942. He also served on the technical personnel board throughout the war. In 1943 Mr. Dick investigated emergency coal production and relative problems in Nova Scotia at the request of the Province of Nova Scotia.

On several occasions in recent years Mr. Dick served on provincial government commissions. Chairman of the Alberta Co-Terminus Boundaries Commission he also headed the Royal Commission on Bow River flood conditions. In 1948 Mr. Dick was president of the Alberta and North Western Chamber of Mines and Resources. At one time he was permanent secretary of the Interprovincial Oil and Gas Board. Mr. Dick had also served as a director of Ducks Unlimited of Canada.

Mr. Dick became an Associate Member of the Institute in 1911. He transferred to Member in 1918, attained Life membership in 1947.

John Goodall Dickenson, M.E.I.C., Toronto mining consultant and former manager and vice-president of the O'Brien Gold Mine Company died at Toronto on January 8, 1958.

Born at Tor Bay, Guysborough County, N.S., on March 17, 1883, Mr. Dickenson had his early schooling with the Nova Scotia Public Schools and at Loyola College, Montreal. He graduated from McGill University, with B.A. and B.Sc. degrees in mining in 1904 and 1907. He held various positions on railway surveys and was employed as a miner in coal and metal mines in Pennsylvania, New York, Idaho, B.C., and Eastern Canada. In 1907, after a period as surveying instructor for McGill University he became a foreman on subway construction with the New York and New Jersey Telephones. Promoted to division commercial engineer with headquarters at Albany, N.Y., in 1909, he remained in this work until 1916. At that time, accepted for the post of manager of the O'Brien Mining Company, he moved to Cobalt, Ont. He was called to head office, Ottawa, as general manager of mines in 1932. Subsequently he became vice-president and general manager of mines. Mr. Dickenson retained this post until his retirement in 1940.

Later he opened an office in Toronto, became interested in the Red Lake district of Ontario, and was instrumental in the development of the New Dickenson mine of that area. In 1948 ill-health forced his resignation.

While at Cobalt Mr. Dickenson directed the development of the first gold mine in the province of Quebec, the O'Brien gold mine at Cadillac.

He joined the Institute as a Student member in 1905, became an Associate member in 1912, and transferred to Member in 1919. He achieved Life membership in the Institute in 1947.

L. H. Laffoley, M.E.I.C., engineer of hotels for the Canadian Pacific Railway, Montreal, died in that city on February 1, 1958.

Laurence Herbert Laffoley was born on March 14, 1894, at Montreal. First associated with the C.P.R. as a draughtsman as early as 1912, he later attended McGill University, graduating with a B.Sc. degree in civil engineering in 1916. He served the Canadian Engineers and the Royal Flying Corps overseas from 1916 to 1918, for part of the time as instructor in military engineering. At war's end returning to Canada he worked as a demonstrator in mechanical draughting at McGill University. The following year he again entered the service of the Canadian Pacific Railway as a draughtsman. Promoted to assistant engineer in 1923 he assumed office as assistant engineer of buildings in 1937. Nine years later he became engineer of buildings.

In 1956 Mr. Laffoley was named to the post of engineer of hotels, retaining the appointment until the time of his death.

Noted for his part in the construction of a great many buildings across Canada, a few of these are, the Royal York Hotel, Toronto, the recent extension to the building, the St. Antoine Street extension to Windsor Station, Montreal, Banff Springs Hotel, Banff, Alta., and the Chateau Frontenac, Quebec, Que., as well as many other large projects associated with the construction and railroad industries.

Mr. Laffoley joined the Institute as a Student member in 1914, transferred to Associate membership in 1921. He became a Member in 1940.

George W. Rayner, M.E.I.C., co-founder and president of the Rayner Construction Company, Toronto, died at Toronto on January 1, 1958.

Born in Suffolk, England, George William Rayner came to Canada at a very early age. He graduated from the University of Toronto in 1905, then followed post-graduate studies in mining. His early work included two years with the Cataract Power Company and the Kaministigua Power Company, in Ontario. He gained experience in prospecting in Northern Ontario, Quebec, and the Queen Charlotte Islands, B.C.

During the nineteen twenties he founded the Rayner Construction Company with A. W. Robertson, was managing director of the Ontario Amcsite Limited, and was associated with the

W. J. Dick, M.E.I.C.

L. H. Laffoley, M.E.I.C.

Fuller Gravel Limited, all at Toronto. Mr. Rayner headed Rayner Atlas Limited, which company was concerned with the hydraulic tunnel under Niagara Falls and with the Iroquois Constructors Limited. The latter was concerned with carrying out power and seaway assignments on the St. Lawrence Seaway.

On completion of the construction of a hydro tunnel on the Mississagi river near Thessalon, Ont., he was in 1951 honoured when the Ontario Hydro-Electric Commission gave the power plant his name.

Mr. Rayner joined the Institute as a Member in 1920. He attained Life membership in the organization in 1954.

A. V. Gale, M.E.I.C., retired vice-president and general manager of the Hull Electric Company, and manager of the Hull division of the Gatineau Power Company, Hull, Que., died on November 1957, at Hull.

Alfred Valiant Gale was born at Quebec City on September 7, 1884. He attended the Quebec High School and Poughkepsie Business College.

Beginning his engineering career as an assistant in the lighting department of the Hull Electric Company in 1907 he rose to the post of superintendent of lighting and distribution for the company in 1912.

His first work in the field of engineering was with the Canadian Rubber Company at Montreal. For many years he was employed as an engineering officer for the Hull Electric Company.

Mr. Gale joined the Institute as an Associate Member in 1916, transferred to Member in 1940 and attained Life Membership in 1952.

R. K. Robertson, M.E.I.C., vice-president of the Laprairie Brick and Tile Company for more than 32 years and vice-president and general manager of the Clay products division of the Dominion Tar and Chemical Company, died at Montreal on December 26, 1957.

Randal Killaly Robertson was born at Dickenson's Landing, Ontario on July 16, 1892. He graduated from the Royal Military College, Kingston, in 1912. Two years later he graduated from McGill University with a B.Sc. degree. His first professional work was with the Toronto firm of Chapman and Power of Toronto, in London where he was engaged in work on sewer construction. From 1915 to 1918 he served with the Canadian Army infantry. He was transferred to the Engineers corps in 1918 in France. On his discharge the following year he held the rank of captain. In 1919 he took charge of the engineering department of the Cooksville Company of Canada Limited and in 1921 he was appointed works manager. In 1924 he joined the Canadian Marconi Company at Montreal. With the expansion of the Cooksville Company into the Quebec area in 1927 he rejoined the firm. In 1933 the company became known as the La Prairie Brick and Tile Company.

Mr. Robertson joined the Institute as an Associate member in 1923, transferred to Member in 1940.

George E. Robertson, father of Mr. R. K. Robertson was one of the chartered members of the E.I.C.

Roland Charles Duquette, M.E.I.C., overhead distribution engineer with the Quebec Hydro-Electric Commission, at Montreal, died in that city on June 20, 1957.

Born at Montreal on January 18, 1915, Mr. Duquette had his early schooling at the Academie St. Paul and Strathcona University. He entered McGill University in 1936 and was graduated with a B.Eng. degree in 1940. While a student he gained experience with the Empire Food Corporation and the Montreal Light, Heat and Power Consolidated. Immediately on graduation he accepted a position as an assistant electrical engineer with the distribution division of the Gatineau Power Company, at Hull, Que. In 1945 he joined the Quebec Hydro-Electric Commission, at Montreal as an electrical engineer. After a number of years' work in this capacity he was in 1954 promoted to overhead distribution engineer for the organization.

Mr. Duquette joined the Engineering Institute as a Student Member in 1940, transferred to Junior member in 1943. He became a Member in 1945.

News of the Associations and Corporation

(Continued from page 116)

BRITISH COLUMBIA (Cont'd)

them are of a non-technical nature. The second group can use the period of slack employment to prepare themselves for the future and make themselves more valuable to future employers. A few suggested studies are accounting and business management courses, labour relations, public speaking, and taking any kind of a job available, for there is something new to learn in every kind of endeavour.

This year is the Centennial year of the Province and from present indications it looks like a year of retrenchment and consolidation, rather than a year of exploration and development as it was a century ago.

ALBERTA

(Taken from a report by H. L. Roblin, committee chairman, published in "The Alberta Professional Engineer," January 1958)

Membership, Enforcement Committee Report

Mr. Roblin states that the two-fold responsibilities of the Committee in that province are to protect the public by making effective the provisions of Section 45 of "The Engineering Profession Act, 1955" and of making the privilege of membership available to all those who are qualified to practice engineering.

In carrying out enforcement duties the committee must deal with all infractions coming to its attention. Thirty cases now being dealt with may be classified as follows:

1. Those people who through ignorance of the provisions of "The Engineering Profession Act" imply wrongly that they can or do practice.
2. Those who seek prestige or advertising gain by describing themselves as professional engineers.
3. Companies using the words "engineer" or "engineering", thereby implying that they are qualified to practice.

The committee has found that many cases can be satisfactorily dealt with through friendly persuasion by either a committee member or the executive-secretary. Corrective action has been taken in about 50 per cent of the cases that have come before the committee in the past year. Most of the remainder are still under review. Where it is not possible to get corrective action in this way, the cases are referred to Council to be sent to the Courts. This course has been adopted in several instances.

One of the major problems facing the committee is that of listings in the telephone directories. This has been discussed with the advertising departments of the telephone companies with a view to improving the situation.

Because of the heavy load of enforcement problems that committee has had little time to give to its membership function. Through the efforts of the executive-secretary and his staff, about two hundred engineers qualified for membership were contacted throughout the province, but there is still a great deal of membership work to be done. In view of the amount of work involved —and for other reasons—it often appears that the subjects of membership and enforcement should be administered by separate committees.

The success of the Membership and Enforcement Committee is in a large measure dependent on the co-operation of the members of the Association.

1958 ANNUAL MEETING
Quebec, Chateau Frontenac,
May 21, 22, 23
(see announcement on page 103 of this issue)

Personals

News of the Personal Activities of Members of the Institute

Dean R. M. Hardy, M.E.I.C., (B.Sc., civil, Manitoba, 1929; M.Sc., McGill, 1930; Hon. D.Sc., Manitoba, 1957), of the faculty of engineering at the University of Alberta, has been named to the six-member Royal Commission on Energy. Canada's oil, natural gas and pipelines industry will be the subject of the Commission's early hearings to be carried on in Western Canada. Formation of a natural gas policy is planned.

D. M. Stephens, M.E.I.C., (B.Sc. civil, Manitoba, 1931), 1954 president of the Engineering Institute, chairman of the Manitoba Hydro-Electric Board, Winnipeg, has been named a member of the Canadian section of the International Joint Commission. A former deputy minister of resources for Manitoba, Mr. Stephens has been chairman of the hydro-electric board since 1951.

Dr. Lyle G. Trorey, M.B.E., M.E.I.C., (B.Sc., London, 1927; Ph.D., London, 1944), consulting engineer of Vancouver has recently been elected a Fellow of the American Association for the Advancement of Science. Dr. Trorey is well-known outside Canada for original scientific and engineering work in a number of fields.

Ian F. McRae, M.E.I.C., of the Canadian General Electric Company Limited, has been elected chairman of the board of directors of the company. He will retain the responsibility of general manager of the civilian atomic power department at Toronto, along with his new duties. Elected a company director earlier this year, Mr. McRae has a long-standing interest in industrial organization work and is currently serving as first vice-president of the Canadian Manufacturers Association.

G. N. Martin, M.E.I.C.

G. H. Midgley, M.E.I.C.

George H. Midgley, M.E.I.C., (B.Sc., mech., Nova Scotia Technical College, 1924), general sales manager of the Dominion Bridge Company, Limited, and formerly also sales manager of the Eastern Division will now devote his entire time to the general sales policies of the Company. Mr. Midgley joined Dominion Bridge Company in 1936, gained the post of general sales manager in 1956.

P. G. A. Brault, M.E.I.C.

J. P. Borbey, M.E.I.C.

John P. Borbey, M.E.I.C., (B.A. Sc., civil, Toronto, 1934), assistant sales manager of the Eastern division of the Dominion Bridge Company Limited has been appointed sales manager of this division. He joined Dominion Bridge in 1936, since then he has held various positions in the engineering and sales departments, until his appointment in 1955 as assistant sales manager of the Eastern division.

Gerald N. Martin, M.E.I.C., (B.Sc., civil, Ecole Polytechnique, 1934), formerly combustion sales engineer with the Dominion Bridge Company Limited has been appointed assistant sales manager with the organization. He has held the position of combustion sales engineer at Dominion Bridge since 1944.

P. G. A. Brault, M.E.I.C., (B.Sc., civil, McGill, 1921), has been appointed assistant chief engineer of the engineering department of the Eastern Division of the Dominion Bridge Company Limited. He formerly held the title of design engineer, Eastern division. Employed with the firm since the early days of his career, his appointment as design engineer dates to 1951.

Dr. G. Vibert Douglas, M.E.I.C., retired professor of geology at Dalhousie University, who recently opened a practice in Toronto as consulting geologist has announced a new address: 40 Sherbourne Street N., Toronto 5, Ont. (See 'Personals', November 1957.)

E. C. Hay, M.E.I.C., (B.A.Sc., elec., U.B.C., 1930), was recently appointed manager of the Vancouver plant, industrial control division of Canadian Westinghouse Company Limited. He formerly served the organization as an application engineer at Vancouver.

Harry M. White, M.E.I.C., (B.Sc., mech., Toronto, 1910), retired from the staff of the Dominion Bridge Company Limited as chief engineer, Western division, in October 1957, after forty-seven years of continuous service with the company. He was retained in a consulting capacity until the end of March, 1958. Mr. White started his duties with the company at Lachine, Que., head office, and then transferred first to the Winnipeg Branch of the firm as designing engineer, then engineer. He became chief engineer of the western division (Manitoba, Saskatchewan and Alberta), in 1930. During World War II he was placed in charge of shell production for the firm.

H. M. White, M.E.I.C.

J. C. Trueman, M.E.I.C.

D. C. Beam, M.E.I.C.

J. C. Trueman, M.E.I.C., (B.Sc., civil, Manitoba, 1923; M.Sc., McGill, 1924), has been appointed chief engineer of the Western division of Dominion Bridge Company Limited. Mr. Trueman joined the company in 1927 as a design engineer and three years later was appointed design engineer, Western division.

M. J. Lupton, M.E.I.C., (B.Sc., mech., Manitoba, 1924; M.Sc., McGill, 1936), has been appointed structural engineer in charge of structural design with the Winnipeg Branch of Dominion Bridge Company Limited. His association with the firm dates to 1936 when he joined the structural design department at head office, Lachine, Que.

Donald C. Beam, M.E.I.C., (B.A.Sc., civil, Toronto, 1928), chief engineer of the Canadian Institute of Steel Construction, Inc., has been appointed general manager of the organization. He joined the Canadian Institute of Steel Construction as chief engineer in charge of its technical program in 1949.

M. J. Lupton, M.E.I.C.

D. L. Tarlton, M.E.I.C.

Derek L. Tarlton, M.E.I.C., (B.A.Sc., civil, Toronto, 1952), has been appointed development engineer with the Canadian Institute of Steel Construction, Inc. Experienced in structural design, in industry and with a firm of consulting engineers, he joined the Institute at the beginning of 1956 as district engineer for Ontario.

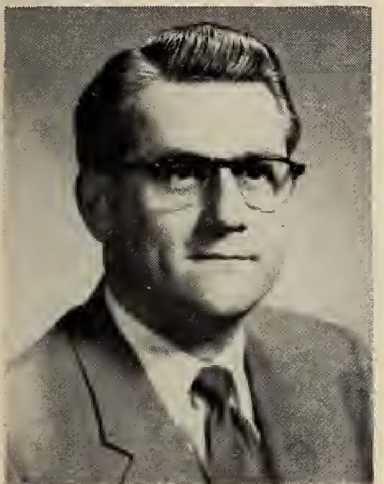
W. L. Todd, M.E.I.C., (B.Eng., mech., McGill, 1941), and **G. J. Monarque**, M.E.I.C., (B.Eng., chem., McGill, 1946), have been named among the officers and senior executive of a newly formed company to be known as Stadler Hurter International Ltd. A private company with offices in Montreal, New York, and Mexico City it will take over all work formerly undertaken outside the Province of Quebec by Stadler, Hurter and Company. The firm will continue to practice in the province as in the past.

B. Hardcastle, M.E.I.C., (B.Sc., civil, Edinburgh, 1945), secretary of the Joint Area Committee of the Toronto Branch of the Engineering Institute, has been named chairman, 1958, of the technical committee of the Petroleum Association of Ontario.

W. C. Wilkinson, M.E.I.C., (B.Sc., elec., New Brunswick, 1937), has left Australia and has accepted an appointment with the Canadian National Telegraphs, radio group, at Toronto. Mr. Wilkinson was formerly with Amalgamated Television Services Party Ltd., at Sydney, Australia as a senior television engineer. Earlier in his career he devoted ten years to the communications field in Canada.

W. G. Huber, M.E.I.C., (B.Sc., civil, Wisconsin, 1920), has resigned his position following three years in which he served as general manager of the B.C. Engineering Company limited, at Vancouver. During the five-year period preceding this appointment which dated to 1954, he held a similar post for B.C. International Engineering Company Limited, principally on the Alcan B.C. Power Development. Mr. Huber will practise in Vancouver as a consultant on heavy civil engineering for the B.C. Engineering Company and other clients.

J. A. D'Angelo, M.E.I.C., whose recent appointment as comptroller of the



J. A. D'Angelo, M.E.I.C.

Joseph Campan engine plant of the Chrysler Corporation, Detroit, was announced in the January issue of the *Journal*, page 104.

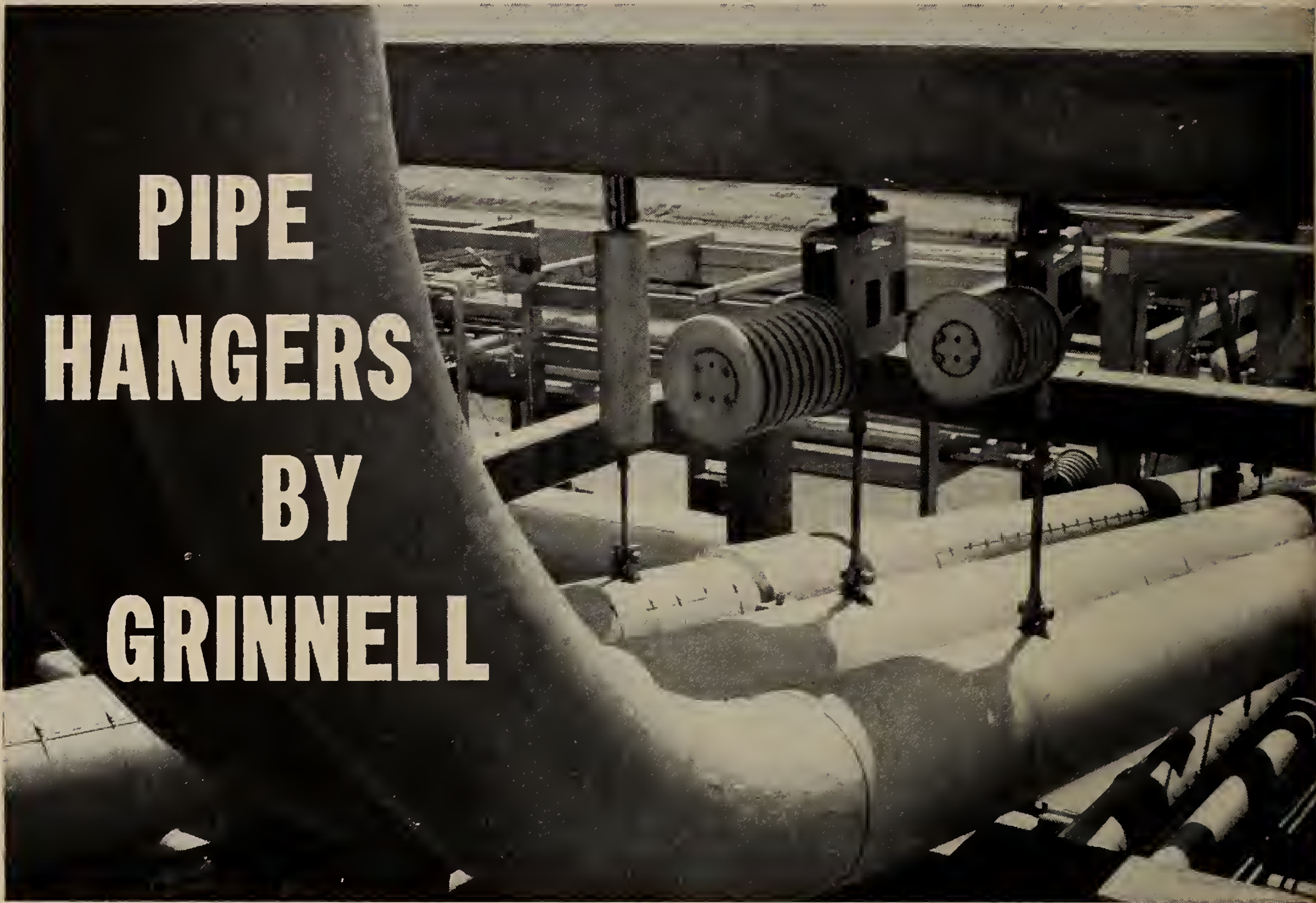
M. L. Laquerre, M.E.I.C., (B.A.Sc., civil, Ecole Polytechnique, 1942), for the past twelve years a member of the firm of Delisle and Laquerre of Chicoutimi, has organized a consulting engineering firm at Jonquiere, Que., with **L. Lemieux**, JR.E.I.C., (B.A.Sc., civil, Ecole Polytechnique, 1955). Mr. Lemieux has been associated with the firm of William Gravel, consulting engineer, Chicoutimi, since graduation.

In his career, to date, Mr. Laquerre has been especially active in building design and construction, sewerage and water supply.

Arthur W. Norman, M.E.I.C., (B.Eng., mech., Nova Scotia Technical College, 1946), has been named assistant to the manager, Wm. Stairs, Son and Morrow,

A. W. Norman, M.E.I.C.

At Tidewater's new Delaware Refinery...



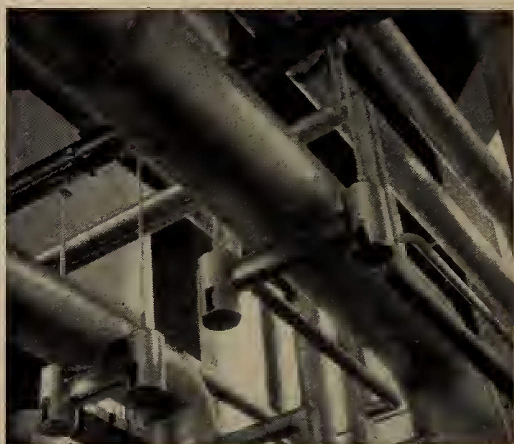
Tidewater Oil Company's new ultramodern $200-million, 5000-acre refinery, south of Wilmington, is the largest ever constructed at one time. Capable of processing 130,000 barrels of crude oil daily, the Delaware Refinery boasts eleven major processing units, including six of world-record size.

Pipe suspension problems, too, were bigger and more challenging at this record-breaking refinery. That's why Tidewater turned to Grinnell for pipe hangers and supports.

A volume producer of pipe hangers, Grinnell backs up its high capacity and diversification with an efficient coast-to-coast network of warehouses and jobbers. Even complex hanger requirements very often can be met with hanger assemblies right off the shelf. This not only saves you time, but it can save you money, by cutting down on the number of special items which must be manufactured.

If you have a pipe suspension problem, you are invited to write: Grinnell Company of Canada, Ltd., Edmonton, Montreal, Toronto, Vancouver.

GRINNELL CONSTANT-SUPPORT HANGERS are engineered to maintain full safety factor. Constancy of support is mathematically perfect for all positions of travel. Note low headroom requirement. Load ranges from 30 lbs. to 32,260 lbs., with travels up to 12 inches.



GRINNELL VARIABLE SPRING HANGERS have pre-compression feature which assures operation of spring within its proper working range. Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes. Available in 21 sizes for loads ranging from 50 lbs. to 28,200 lbs.

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• PERSONALS

Limited, construction machinery division at Halifax, N.S. Since his graduation Mr. Norman has held posts with the Construction Equipment Company, Limited, and with the Atlantic Tug and Equipment Company, Inc.

CORRECTION: In the Personals Section of the *Journal*, January issue, it was wrongly stated that R. Walker, M.E.I.C., of the Associated Engineering Services Ltd., Edmonton, had been appointed chief electrical engineer with the firm. Actually the appointment is that of chief industrial engineer. The Journal regrets the error.

A. Gordon Macdonald, JR.E.I.C., (B.Eng., elec., McGill, 1953), has left the firm of Burns and Company, where he was employed at head office, engineering department, Calgary, Alta., and has accepted employment in the Calgary office of Brown and Root Limited, engineers and constructors.

Gordon Gracie, JR.E.I.C., (B.A.Sc., civil, Toronto, 1952), has accepted the appointment of instructor in civil engineering with the University of Illinois, Urbana, Ill. Mr. Gracie who intends to carry on further studies in structural engineering has recently obtained a degree in photogrammetric engineering from the International Training Centre for Aerial Survey at Delft, Holland.

Phil. H. Walker, JR.E.I.C., (B.Sc., civil, Alberta, 1956), formerly employed by K. C. Stanley and Associates, architects and engineers, of Edmonton, as an assistant structural design engineer has joined the City of Edmonton engineering staff. Associated with the waterworks department his appointment is that of chief engineer.

Donald K. Turner, JR.E.I.C., (B.A.Sc., civil, Toronto, 1954), has been appointed regional engineer for Ontario with the Canadian Institute of Steel Construction,

D. K. Turner, JR.E.I.C.

• PERSONALS

Inc. He was previously employed by the City of Toronto building department as plan examiner. In his present position he will service needs of designers and users of structural steel in his region.

Flight Lieutenant Kenneth E. Rideout, JR.E.I.C., (B.S., civil, New Brunswick, 1950), has been promoted to the rank of squadron leader. He is stationed at Randolph Air Force Base, San Antonio, Texas, on a two-year exchange posting with the United States Air Force.

F. H. Sutcliffe, JR.E.I.C., (B.Eng., civil, McGill, 1953), structural engineer, with the Foundation of Canada Engineering Corporation, bridge department, Montreal, is among those engineers who have quite recently benefitted from an Athlone Fellowship. Enrolled at the Imperial College of Science and Technology, London, he studied concrete technology and gained the Diploma of the Imperial College, (D.I.C.). During his second year in Great Britain Mr. Sutcliffe worked with the firm of Stressed Concrete Design Limited, a subsidiary of E. J. Cook and Company, (Engineers) Limited, specializing in prestressed concrete design and construction.

G. B. Weld, JR.E.I.C., (B.Eng., mech., N.S.T.C., 1955), returned to Canada three months ago, following twenty months engineering experience in Great Britain under the provisions of an Athlone Fellowship. Mr. Weld spent six months at Loughborough, England, at the Brush Factory, on the design and manufacture of steam turbines. For an additional thirteen months he was engaged in research on the running-in of lubricated gear mechanisms. He was awarded a master of engineering degree.

Now associated with the National Research Council Mr. Weld is with the Atlantic Regional Laboratory, Halifax, N.S.

H. M. Tomlinson, JR.E.I.C., (B.Eng., civil, N.S.T.C., 1954), has left the staff of the Shawinigan Engineering Company, Shawinigan Falls, Que., and is now resident in Newfoundland. Mr. Tomlinson is employed with the Department of Transport, Government of Canada, at St. John's.

Bjorn Pedersen, JR.E.I.C., (B.Sc., elec., Manitoba, 1956), is engaged in the work of junior research offices, with National Research Council, radio and electrical engineering division, at Ottawa.

Barry J. Ferries, JR.E.I.C., (B.Sc., mech., Manitoba, 1955), has severed his connections with the Amalgamated Electric Corporation Limited, Winnipeg, and has accepted the appointment of chief engineer with the Inter-City Gas Company Limited at Portage La Prairie, Man.

J. W. Marshall, JR.E.I.C., (B.A.Sc., mech., Toronto, 1953, holds the post of lecturer in management, and engineering, at the Ryerson Institute of Technology, Toronto.

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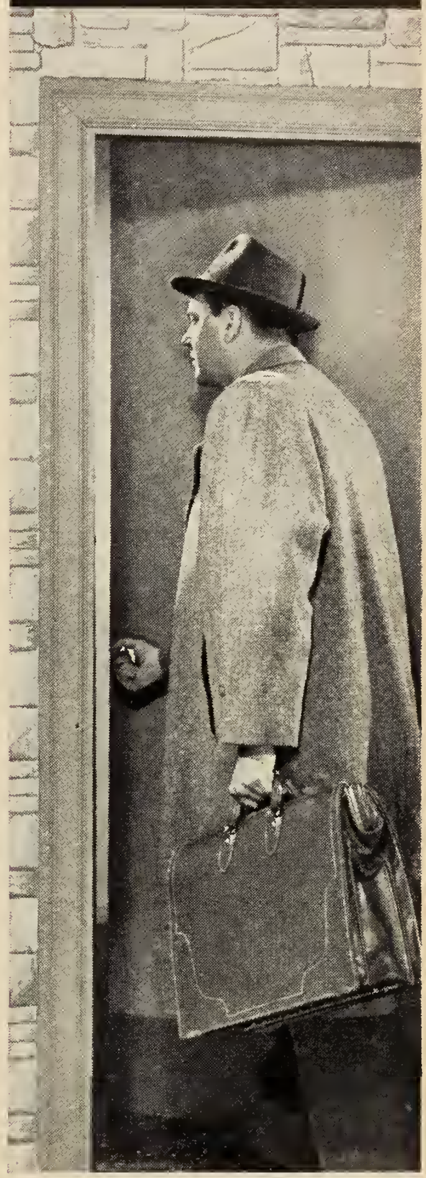

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NEWS OF THE BRANCHES

Activities of the Forty-Nine Branches of the Institute and abstracts of the papers presented at their meetings

BELLEVILLE

F. E. Moore, M.E.I.C., *Sec.-Treas.*

T. E. Flinn, M.E.I.C., *Branch News Editor*

CONTRIBUTIONS TO PUBLIC HEALTH have not been overlooked by the engineer, according to Dr. Milton G. Townsend, medical director, Northern Electric Company Limited, Montreal. Dr. Townsend addressed the Belleville Branch at a meeting held January 13, 1958. Engineers, he explained, had contributed to the good health of mankind in the development of processes for the mass production of drugs, and in the design and construction of such public works as sewage disposal and filtration plants, so vital to public health. He also credited the engineer with the sense of responsibility which called on him to determine health hazards in the processes of his design and to find suitable solution for the problem.

Absenteeism, occupational diseases, and the new hazard of radioactivity were discussed. The study of attendance records was mentioned as the best method of studying the health of employees in industry. In certain plants it had been found that 5 per cent of the employees were responsible for 50 per cent of time lost due to illness. A great deal of absenteeism in industry invites question from the medical point of view. This appears to be closely associated with employee attitude to the job. The supervisor rather than the company physician is in the best position to help such employees.

Effects of noise on human behaviour was a part of the discussion.

Shown here are some of the newly elected officers of the Halifax Branch. Left to right are: B. E. Langley, Bridgewater; W. J. Phillips, vice-chairman; J. D. Kline, chairman; J. G. Bell, executive, Halifax; K. R. Mitchell, Halifax.

Taken at a meeting of the Eastern Township Branch on the occasion of a talk given by R. L. Beck, of the Canadian General Electric Company, Limited, on January 10, 1958. Left to right are G. P. Cote, C. D. Borror, C.I.M.M., Branch chairman; R. D. Mawhood, Branch chairman, E.I.C.; R. L. Beck; A. C. Stevens; Jean Bourassa; Eric Webster; J. M. Fletcher, C.I.M.M. Branch secretary-treasurer; and G. M. Dick, vice-president, E.I.C.

BROCKVILLE

G. R. Bowes, JR.E.I.C., *Sec.-Treas.*

W. E. Morden, M.E.I.C.,
Branch News Editor

PROBLEMS AND RESPONSIBILITIES of management were up for discussion on January 23, 1958 when the Brockville Branch and the Professional Development Group gathered to hear a talk by L. Cunningham, personnel director and secretary of the United Steel Corporation Limited. He divided the responsibilities of management into three groups: shareholders, employees, and to the public or consumer.

Mr. Cunningham stressed the importance of acquainting the employee with the many fringe benefits that are provided. He felt that the monetary value of such things as a pension plan, insurance and paid holidays should be evaluated as a part of the income. He went on to discuss what he considered to be the correct way to pay for a job, the problem of obtaining sufficiently skilled artisans, union negotiation and other problems.

Forty-five members and guests attended the meeting chaired by Eric Ward.

EASTERN TOWNSHIPS

Jean Bourassa, JR.E.I.C., *Secretary*

PROGRESS IN ATOMIC ENERGY was reviewed for the Eastern Townships Branch, E.I.C., and the Sherbrooke Branch of the Canadian Institute of Mining and Metallurgy at a meeting, January 10, 1958. R. L. Beck, application engineer, Canadian General Electric Company, civilian department of atomic energy, presented the address.

Introducing his talk with an explanation of the basic principles of nuclear fission, Mr. Beck followed this with a review of the various installations of atomic reactors. He recalled the early experiments on atomic energy during the war, and the tremendous efforts which contributed to the production of atomic bombs. The early peaceful application of atomic energy was made possible by the developments in radioactive isotopes in agriculture, cobalt bombs in the treatment for cancer and atomic reactors for power generation. The basic elements of a reactor were outlined and the operation explained.

Various reactor installations in the United Kingdom, the United States and Canada were reviewed as well as main features of important installations.

Mr. Beck pointed out the important achievements performed by the Canadian group at Chalk River, Ont. In spite of recent discoveries of oil and natural gas in the Western provinces, Canada remains significant in the import of energy. When nuclear power takes its place among fuels less expensive than conventional fuel plants, Canada, he felt, may enjoy an improved trade balance.

Finally Mr. Beck discussed the economic factors related to the production of nuclear power: capital expenditure, operating costs, and fuel costs. E.I.C. branch chairman R. D. Mawhood extended a welcome to the large turn-out of C.I.M.M. members.

HALIFAX

J. E. Reardon, M.E.I.C., *Sec.-Treas.*

G. H. Dunphy, M.E.I.C., *Branch News Reporter*

The 1957 annual meeting of the Halifax Branch took place in the Nova Scotia Hotel on December 17.

A one minute silence for deceased members preceded approval of the annual minutes.

A highlight of the meeting was the discussion regarding students activities and guidance. Professor M. L. Baker and assistant professor V. E. Vaughan presented reports on these subjects. Professor Baker stressed the fact the E.I.C., through its Nova Scotia membership are giving advice and guidance to matriculation students in our high schools regarding the choice of engineering as a profession. Professor Baker expressed the hope that these activities would increase. He commented on the E.I.C. publication, "Engineering Careers in Canada", which has been distributed to freshmen and final year engineers, and in limited number to high schools. Enthusiastic discussion ensued. It was generally felt that the utmost should be done to assist in this program.

F. C. Bennett outlined the activities at the annual meeting of the E.I.C., and provided a brief summary of Council activities.

In his report on confederation, H. W. L. Doane, vice-president of the Institute, gave some encouragement that progress was being made in this direction.

Chairman J. D. Kline reviewed the activities of the Branch during 1957. Twelve meetings, including two field trips took place.

The following were elected to office: chairman, J. D. Kline; vice-chairman, W. J. Phillips; executive for Halifax area, J. G. Bell, G. McD. Haliburton, K. R. Mitchell; executive for area outside Halifax, J. R. Cameron of Milford, and B. E. Langley of Bridgewater.

HAMILTON

W. A. H. Filer, JR.E.I.C., *Sec.-Treas.*

J. R. Currie, M.E.I.C., *Branch News Editor*

The annual meeting of the Hamilton Branch was held January 16, 1958 at the Hamilton Golf and Country Club at Ancaster, Ont. The evening speaker, A. P. Craig, vice-president, Trans-Canada Pipeline delivered a talk entitled, "Up-

To-Date with Trans-Canada Pipeline". Many comparisons illustrating the impact of the Trans-Canada Pipeline on the Canadian economy were given. The talk was accompanied by color film of pipeline laying operations and general operating aspects.

One interesting sidelight of the pipeline will be the production of sulphur as a by-product in the processing of the raw gas. This sulphur production will amount to 1,000 tons per day, more than replacing the amount of sulphur now being imported from the United States. When in full operation Trans-Canada Pipeline expcets to provide about 30,000 permanent jobs in the operation and maintenance of the pipeline. Mr. Craig mentioned the impact on the economy through the establishment of supplier plants such as Page Hersey Tubes Limited. Reporting briefly the stages through which the project moved during the financing arrangements, he noted that firm commitments covering gas deliveries for twenty years were required of the major utilities in Eastern Canada covering upwards of two billion dollars in total sales before senior financing could be arranged. Since signing of the original contract, the utilities have revised their requirements drastically upward, with the result that Trans-Canada Pipeline expect to reach maximum through-put in about 1962.

With reference to the construction progress, Mr. Craig stated that the pipeline was 60 per cent completed by the end of 1957 and his company expects to have the pipeline fully completed by the end of this year. Natural gas already serves communities as far east as the lakehead.

Following Mr. Craig's address, the election of officers of the Branch took place, with R. C. Mitchell elected chairman, H. E. Seely, vice-chairman, and W. A. H. Filer, sec.-treas.

HURONIA

L. Morgante, JR.E.I.C., *Sec.-Treas.*

B. C. Lamble, M.E.I.C., *Branch News Editor*

GEOLOGY IN LABRADOR was the subject of discussion at the monthly meeting of the Huronia Branch, at Orillia, Ont., on January 16, 1958, when Dr. George Vilbert Douglas gave a talk. One of the most distinguished geologists in the country, Dr. Douglas has travelled the world as a representative of government and scientific bodies. His address was entitled, "The Geology of the Labrador Coast."

The geological survey in Labrador, profusely illustrated by lantern slides, was conducted for the former Government of Newfoundland, primarily to locate mineral deposits. Dr. Douglas went into great detail to explain the rock formations and deposits encountered during the trip and gave many interesting accounts of his geological studies. He spoke highly of his staff of 12 men, all of them outstanding geologists and engineers.

The audience numbering 30 included two representatives from Toronto. They were J. H. McLaren, Eastern field secretary of the Institute, and T. Keefer, travelling secretary of the Professional Engineers of Ontario.

Shown together at a meeting of the Huronia Branch, held January 16, 1958 are, left to right: F. Alport, Dr. G. Vibert Douglas, and H. C. Bates, Branch chairman. Dr. Douglas a noted geologist, addressed the meeting on "The Geology of the Labrador Coast".

• BRANCH NEWS

KINGSTON

D. I. Ourom, JR.E.I.C., *Sec.-Treas.*

A PANEL DISCUSSION on engineering education was arranged for February 6, 1958 for all those interested in discussing the topic of education. Moderated by L. F. Grant, retired field secretary of the Institute, teacher and alderman, panel members were Prof. D. M. Jemmett, electrical engineering, Queen's; V. S. Ready, principal, K.C.V.I.; D. L. Rigsby, general superintendent of engineering and services, Aluminum Company of Canada Limited; and R. W. T. Birchard, assistant engineer, Canadian Industries Limited.

During the past few years increasing public interest has been directed to the modern educational system recently prominent in the news. Therefore it was decided that an open discussion should be held for all those members and friends who might care to show an interest or express an opinion.

LAKEHEAD

C. M. Cotton, JR.E.I.C., *Sec.-Treas.*

George A. Walker, JR.E.I.C., *Publicity Chairman*

PERHAPS THE MOST OUTSTANDING meeting of the current year was held at the Fort William Armouries in January when a team of three engineer members of the Branch from Canadian Car Company Limited took over. The evening was spent in observation of the development work of the company's new air suspension system on the busses. One of the company busses especially adjusted for demonstration purposes was used. The under-chassis lights were turned on the suspension units and it was possible to see the new system in action. The members were impressed by the quietness and smoothness of the ride, an outstanding feature of this particular suspension system.

Automotive project engineer, N. Kuster, provided introductory remarks, while J. Rymes dealt with the suspension layout covering the unique problems encountered during the design and the solutions now available. It was illustrated that the application of patented air suspension system could be made in fields of transportation other than the bus industry.

Interesting comments on the new air suspension system offered by the automobile manufacturers were passed on. More than 50 members turned out.

LONDON

G. W. Chorley, M.E.I.C., *Sec.-Treas.*

AN ADDRESS ENTITLED "CANADA", was read by V. B. King, of King Trucks Limited, London, Ont., before the London Branch on January 21, 1958.

Mr. King urged that Canadians bring to light the problems of the nation, to face and overcome them by realistic measures. In this way he felt Canada would gain its real place in the sun.

Mr. King began his talk by remarking that a great deal is said about the progress and future of this country. It has been popular to call it an unknown country, to extoll its greatness, and to raise new horizons. It had become desirable to promote a feeling of strong national pride, perhaps to counteract the constant unfluence of the United States, and the feelings derived from our recent colonial status he suggested. As regards the former issue as a factor in our behavior, Mr. King felt that while our material standard of living is almost as high as in the United States the differential still attracts many of our best young people who emigrate to the U.S. So long as Canadians are complacent about the fact that this country is not sufficiently attractive to keep Canadians at home to take part in the development of the country, Mr. King warned, they will be attracted to the United States.

Canada has also proved complacent on the educational system. "If we cannot find ways and means of developing this, our best natural resource, we do not deserve better than mediocrity in the field of science," he said.

Turning his thoughts to legislation Mr. King stated that security and welfare have been demanded by and given to Canadians in numerous ways. However, he pointed out, increased service through pressure on the government for benefits, boosts the tax-rate and in the process the incentive for individuals and corporations to work and strive diminishes. High taxation inhibits corporations from expanding, thus limiting the employment potential of industry. This may discourage industry. This and other factors may actually bring about the flight of industry from a community or even from the country. Mr. King cited an instance of a company who had concluded that economic and other conditions here were not conducive to the continuation of business, and closed down. He suggested that no attempt was made on the part of any government to approach the company to discuss its difficulties or to try to determine if anything might be done to induce it to continue its operations here.

That the climate for industry and manufacturing in this country is excellent, Mr. King believed was a popular fallacy. He suggested that this applied especially with respect to secondary manufacturing, firstly from the question of taxation where difficulties in connection with the corporation tax, sales tax, and succession duties in the case of private ownership exist. Mr. King felt that manufacturing should receive benefits comparable to the mining industry and agriculture which are granted a tax-exemption for a tune-up period, and for three years thereafter. The tariff protection or umbrella under which secondary industry operates is uncertain, he went on, stating that although he would not advocate that tariffs be raised, "the trick," he said, "is to obtain 'Made in Canada' status." Until this is accomplished a company must operate with little or no tariff protection, and an unfavourable exchange rate. He also urged a policy of "buy Canadian" as important to the welfare of this country. While manufacturing had not kept pace with the boom Canada had been experiencing, the main benefit of the big Canadian boom since 1953, he said, had gone to U.S. manufacturers of both capital and consumer goods.

Mr. King appealed to Canadians to become better acquainted with the Canadian Arctic and sub-Arctic through organized group trips. "If Canadians do not study and know our Arctic and sub-Arctic and prepare for feasible and economic developments," he said, "do we deserve to hold this vast territory?"

He also mentioned Canada's growing part in the organization known as UPADI.

In closing Mr. King remarked that the purpose of his talk had not been to be critical or pessimistic. All of these situations mentioned could and must in time be corrected.

NIPISSING AND UPPER OTTAWA

R. A. Booy, JR.E.I.C., *Sec.-Treas.*

J. W. Millar, M.E.I.C., *Branch News Editor*

A social evening devoted to mixed curling was an event of December 10, at Temiskaming, Que. Bad weather failed to impede either attendance or enjoyment.

Aerial Photography

Aerial photography invoked sufficient interest among Branch members to draw a large attendance to hear Lt. Col. J. A. Warburton deliver an address on the "Interpretation and Utilization of Aerial Photographs for Engineering Purposes." The occasion was the regular monthly meeting at the King Edward Hotel at Sturgeon Falls, Ont., January 15, 1958.

Mr. Warburton who displayed a collection of aerial photographs and maps made from aerial photographs, showed a film which portrayed a plane taking off with crew and photographic equipment, the taking of photographs from the air, development of the film, study of the prints, and later the actual tracing of maps from the aerial photographs by the use of special viewing machines.

Aerial photography was actually started in the mid-nineteenth century when photographs were taken from captive balloons. Wide use of aerial photography was made in World War I for locating enemy trenches and gun emplacements. Before the Armistice was signed, the full significance of aerial photography was realized, and a civilian committee was set up to study aerial surveys for civilian use.

Photogrammetic surveys are useful in making forest inventory, and it is possible to determine size of limit, type of wood, and estimate height of trees. It is valuable in preliminary locations of highways and railways as it saves arduous ground surveys, and can be used to gauge flood waters and estimate the size of culverts. It can be used for estimating the contents of stock piles of coal or wood or the size of gravel pits. In all these instances it is necessary to have two or more actual points of reference determined by actual ground survey. The nature of the ground under clear water can be studied from aerial photographs, and aerial surveys were extensively used in preliminary work on the Dew Line and the Trans-Canada microwave system.

In studying aerial photographs or making maps from them, it is necessary to have pairs of photographs, each photograph in the pair overlapping the other by about 60 per cent. Then these pairs of photographs are studied in stereoscopic machines which bring out the subject in three dimensions. In mapping, the lines of contours can be followed rapidly and duplicated on a map by special machines.

ST. MAURICE VALLEY

J. O. Hachey, JR.E.I.C., *Secretary*

E. A. Love, JR.E.I.C.,

Publicity Committee

DR. JACQUES BELAND, of the Department of Mines and Resources of the Province of Quebec, on November 4, 1957, gave an interesting talk on the geology of the St. Maurice Valley. He discussed the formation found in the valley, the reasons for them, as well as the geology of the eastern part of the country. Coloured slides were used to illustrate the talk which was followed by a lively question and answer period.

President's Visit

President Anson, Dr. L. A. Wright, and G. M. Dick, regional vice-president of the Institute, Mrs. Dick and Mrs. Anson visited the Branch on November 26, 1957. A luncheon was held at Laurentide Inn, Grand'Mere, with the executive and their wives acting as hosts for the occasion. This was followed by an executive meeting in the afternoon.

Mrs. Anson and Mrs. Dick were entertained by Mrs. W. Seline and Mrs. E. A. Love. A tour of the Grand-Mere Knitting Mills, followed by a dinner.

In the evening a Branch dinner was held at the Laurentide Inn, Grand'Mere after which President Anson delivered a timely address to those assembled. He was introduced by E. A. Love and thanked by E. T. Buchanan.

SAULT STE. MARIE

R. L. Wimperis, JR.E.I.C., *Sec.-Treas.*

THE ANNUAL BRANCH MEETING was held January 10, 1958. Reports were heard from the papers, membership and entertainment committees in review of activities during 1957. The financial statement was read and auditors appointed.

R. H. Tooley, newly elected Branch chairman expressed his optimism for 1958 as a successful year for the branch.

W. D. Adams, Life Member

W. D. Adams, for thirty-five years a member of the E.I.C., attained Life Membership effective January 1, 1958. Mr. Adams graduated from the Royal Military College in 1908. Overseas in World War I with the 14 Battalion he was mentioned in dispatches, received the Military Cross. He has been associated in his engineering career with the Toronto Transportation Commission, the firm of Walter J. Francis, Toronto, and the Algoma Steel Corporation. He joined the latter in 1939, retired in 1957.

SUDBURY

W. J. Ripley, JR.E.I.C., *Sec.-Treas.*

M. D. Head, M.E.I.C., *Publicity Committee*

THE JANUARY DINNER MEETING of the Sudbury Branch, was held at the Granite Club, January 16 with 28 members and guests attending. First speaker of the evening Father Y. Ferland, dean of the faculty of arts of the University of Sudbury, chose to acquaint members with the new university's aims and plans for a faculty of engineering, which is to be opened next fall. He pointed out that the district normally provides about 50 new engineering students each year. There were indications that this number would increase appreciably with the provision of the new university's facilities. Initially only first and second year courses will be offered, and Toronto and other universities will accept Sudbury students for their third and fourth years. In due course Sudbury will offer facilities for studies in at least one branch of engineering through all four years. Tuition fees will probably be about $350 per year. Entrance qualifications will be the same as those of the University of Toronto. Three floors of the Empire Building are to be rented until a building is erected on the new campus in Neelon-Garson township. Financing of the new undertaking would be provided by students' fees plus contributions from the Federal, Provincial and municipal governments, and industrial organizations. Staff will be recruited from among suitably qualified professors from other Jesuit universities, and it is hoped to obtain lay teachers from University of Toronto staff. Father Ferland also invited local engineers to deliver part time courses of two or three lectures per week. In the faculty of engineering all instruction will be given in English. The faculty of arts will organise separate French and English speaking colleges.

The thanks of the meeting were expressed by Lennox Lane.

Dr. B. M. Wilson of Sudbury, second speaker, discussed civil defence co-ordination in terms of the ABC of total war, atomic, bacteriological and chemical. Civil defence planning apparently places most emphasis on combatting the effects of atomic warfare. The general effects of nuclear explosions and the damage caused by heat, blast, immediate radiation and delayed radiation or "fallout", and in precautions for mitigation of harmful effects were indicated. Finally Dr. Wilson described in outline the Civil Defence Organization that has been set up to meet the emergencies of a modern war.

TORONTO

D. S. Moyer, M.E.I.C., *Sec.-Treas.*

A. C. Davidson, M.E.I.C.,

Branch News Reporter

THE ANNUAL MEETING held January 17 and attended by 100 persons, provided an occasion for the Toronto Branch to recognize the work carried out by Col. L. F. Grant, retiring field secretary. Binoculars and a wind gauge, both for use on his "racing" yacht were presented by retiring Branch chairman E. R. Davis. Colonel Grant remarked with usual gentle good humour that the binoculars would be a most welcome gift in that in a race he would now be able to make out the stern of the nearest competitor.

After the business of the meeting was dealt with a scrutineers' report was read by Dunc Whitson. New officers elected were: chairman, Harvey Self; vice-chairman, A. C. Davidson; senior members of the executive: Dean R. R. McLaughin, faculty of applied science and engineering; I. S. Patterson, and Russel Rule. Junior members of the executive elected were: S. Gauley and Morgan Price. Members of the executive whose term is not yet finished, continue for another year.

Following the business meeting, Profesor M. W. Hewer of the department of mining engineering at the University of Toronto gave an illustrated lecture on "Life in Pakistan". These were impressions gathered while Professor Hewer was on leave of absence to supervise work sponsored by Canada under the Colombo plan. The commentary was good, as were the slides. The entire evening was enjoyed. In the words of General Secretary, Dr. L. Austin Wright, it was wonderful to be with a group who budgetted for a deficit and made their budget.

Professional Development

Professional development program director W. W. Walker and his committee who invited fourth year engineering students, University of Toronto, to meet with approximately 30 members of the P.D. course got together on January 27, 1958. Arranged in order to provide an opportunity of discussing informally with them the experience of recent graduates in engineering, especial attention was given to counselling them in the matter of choosing positions and companies in the engineering field.

Professor Davidson, the Institute liaison member with the student body, acted as chairman. Mr. Walker addressed the students on the aims of Professional Development and gave sound advice to young engineers about to graduate.

J. A. McLaren, Eastern Field Secretary of the Institute outlined the aims of the Institute, its part in sponsoring P.D. courses, and the efforts made on the part of Colonel L. F. Grant, retired


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eastern field secretary, in organizing courses throughout numerous branches of the Institute.

For discussion purposes the group of 60 students and 30 graduates were distributed at 5 tables. A graduate engineer initiated the discussion of employment and employees and responded to undergraduate queries.

Student representative Norman Seagram, thanked Mr. Walker and members for their efforts on behalf of the students.

Joint Meeting E.I.C.-I.C.E.-A.S.C.E.

The Joint Toronto Area Committee on February 6, 1958 heard G. R. Stunden, director and supervising engineer, Atlas Construction Company, in an address on Earth Moving and Earth Moving Equipment, as applied to the St. Lawrence Seaway project. Mr. Stunden summarized the excavation phases of the various contracts involved in the project and the types of equipment and number of units.

Students' Night

The Toronto Branch played host to seven teams of students from the faculty of applied science and engineering, University of Toronto on February 7, 1958. The contest was closed for a quiz offering substantial cash prizes and called the "$64.00 Question". Winners were the Electrical Club and the Engineering Business Club, tied, followed by the Mining and Metallurgical Club who took second place. Each team member drew a prize and the evening was enjoyed by contestants and audience alike.

Arrangements were under the direction of C. MacInnis, assisted by Norm Seagram. Professor L. E. Jones, A. Toye, and Harry Tryhorn acted as moderator and judges. Coffee and doughnuts were served in the Great Hall.

Joint E.I.C.-I.E.F. Meeting

The problem of transformer noise was discussed by A. T. Edwards, research engineer with the Hydro-Electric Power Commission of Ontario at a joint meeting of the Toronto Branches of the E.I.C. and the I.E.E., on February 11, 1958. Mr. Edwards has had considerable experience on vibration and acoustic problems. In addition to the purely technical aspects of the subject he discussed "Neighborhood Reaction," in such places where transformers are located close to residential areas.

VANCOUVER

A. D. Cronk, JR.E.I.C., *Secretary*

J. J. Kaller, M.E.I.C., *Publicity Branch*

ENGINEERING ETHICS was the subject of a panel discussion, moderated by Dr. H. C. Gunning at a joint meeting of the Vancouver Branch, E.I.C., and the Association of Professional Engineers. Panel members were: D. F. Kidd, consulting

• BRANCH NEWS

mining geologist, V. M. W. Gsyther, consulting engineer and G. M. Ellis, chief engineer, Pacific division, Commonwealth Construction. Each member of the panel made a short statement on engineering ethics relating particularly to their respective fields of engineering activity. An exceptionally large number of questions and problems were submitted for comment. Great numbers of these remained unanswered at the end of the evening. The interest in the topic manifested itself in a resolution that the undiscussed problems receive comment in the B.C. Professional Engineer, preferably as a new and permanent feature of that publication.

1958 Professional Development Course

The importance of such a course and the caliber of speakers engaged has influenced the Vancouver Branch executive in making the 1958 Professional Development course available to the general public. The subject of economics, with special reference to B.C. and its natural resources is being discussed during February and March. It was thought to be of great value to those interested in the economy of the province of British Columbia.

Eight Wednesday evening lectures arranged under the direction of Dr. A. D. Scott of the department of economics of the University of British Columbia, feature addresses by prominent business men, outstanding in their respective fields and representative of the primary industries of B.C.

Top-flight economists and engineers have much in common in that their work revolves around "logical thinking" and the application of a few basic laws. With a little insight into the fundamentals of economics, the engineer can learn to add a new dimension to his thinking.

VANCOUVER ISLAND

J. A. Cowlin, JR.E.I.C., *Sec.-Treas.*

THE FIRST MEETING of the year, held January 22, 1958, successfully commenced the 1958 session.

Philip J. Croft, stations engineer for the B.C. Power Commission offered an illustrated talk on "Field Problems with Power Cables." Croft is well-known across Canada in the power field as a result of the number of years spent with Canada Wire and Cable Company as chief engineer. His presentation of some of the power cable problems was so developed as to be of considerable interest to all engineers, regardless of specialty.

Joint meetings with the Association of Professional Engineers have been discontinued in Victoria, and accordingly, the Institute and the Association sponsor alternate meetings. January's meeting was the first such affair and was held at a new location. An attendance of 40 caused disappointment, however, it is expected that as the new arrangements are better known attendance will improve.

News of Other Societies

C.C.A. Annual Meeting at Quebec

The 40th annual meeting of the Canadian Construction Association was held at the Chateau Frontenac, Quebec City, January 26-29, 1958. Some 1,000 delegates and their wives were welcomed to the city by His Worship Mayor Wilfrid Hamel. H. J. Ball, president of Ball Brothers Ltd., Kitchener, Ont., was elected President of the Association for 1958.

Following registration and meetings of the Management and Resolutions Committees on January 26, the Monday morning session was devoted to presentation of reports from the committees.

Reports of Committees

Chairman H. C. Nicholls of the Apprenticeship Committee reported apprentice registrations at 8,224, up by more than 7 per cent over the 1956 figure for the eight provinces having agreements with the Federal Government. He recommended more activity and encouragement by local committees, careful selection of candidates and a greater interest on the part of employers.

Business and Contractor Relations Committee Chairman, R. F. Legget, told the meeting the most difficult question his committee faced had been the use of bid depositories in connection with tenders for major federal public works. Formal approach to government authorities, he said, must wait until existing bid depositories have worked out a satisfactory system of co-operation to assure that no firm could possibly be excluded from submitting a bid. Following his committee's review of the 'Code of Good Practice' he called for a resolution endorsing the code in its new form. His report included a synopsis of the recently conducted C.C.A. bid depository survey.

Chairman Robert Hewitt of the Construction Equipment Committee reported that major projects during 1957 had been revision of the C.C.A. rental guide, and completion of a brief to the Minister of National Revenue regarding "Capital Cost Allowance Rates on Contractors Movable Equipment". The committee was hopeful that the rate for the 'average' capital cost allowance would be increased and/or recognition given to conditions that seriously reduce the effective life of equipment.

The Supreme Court of Canada, he said, had expressed its desire to re-hear evidence on the appeal from Tariff Board and Exchequer Court rulings regarding power shovels. There was an abnormal surplus of used equipment on the Canadian market due to conclusion of several large projects. There was also a trend to equipping larger projects with new machines and selling them off at the end of a job.

V. L. Leigh, Chairman of the Housing Committee, told the meeting completions in 1957 had risen to around 118,000 compared to a predicted total of 100,000 and the large number of 'starts' in the second half of the year together with a predicted decrease in competing demands for investment funds gave promise of an increasing housing program in 1958.

He expressed belief that the C.C.A. Housing Conference last November would be remembered as an important milestone in the history of the house building section of the industry. His committee is looking forward to a follow-up conference next spring.

Labour Relations Committee Chairman J. J. Pigott, recommended steps that must be taken by all member companies of the C.C.A. throughout Canada if the labour problems of contractors were to be met. Just as the building trade unions have co-ordinated their planning, policies and operations to their advantage across the nation it is essential that employers develop a similar program of co-ordinated effort, in his opinion.

His committee proposed that an experienced labour-relations man be added to the C.C.A. staff.

Reviewing highlights of C.C.A labour relations activities during the past year, Mr. Pigott reported that Messrs. Allan C. Ross and Raymond Brunet continued to represent the C.C.A. on the Canada Labour Relations Board and the National Employment Advisory Committee respectively. Messrs F. W. Purdy and Don Chutter had been the Association's delegates to the 1957 International Labour Conference at Geneva.

Income and Sales Tax

Legislation Committee Chairman, J. Hastie Holden, told delegates the main subject occupying the attention of his committee last year had been the Income Tax Act as it related to reporting of profits on lump-sum projects. Recommendations in the C.C.A. Brief to National Revenue in July 1956 had not been accepted and in January 1957 a decision had been handed down that 'no change in departmental procedure should be made at the present time'. A new brief had been submitted last December.

There had been an increase in overall C.C.A. efforts to obtain legislative changes during the year. The practice of presenting a detailed submission by a C.C.A. delegation to the federal cabinet was extended to include five provincial cabinets. Amendments to the National Housing Act were enacted in accordance with C.C.A. representations.

W. A. Marshall, chairman of the Sales Tax Committee, told the meeting his committee had continued to advocate a general exemption from federal sales tax to all construction materials and equipment. While most, though not all house building materials are exempt from sales tax, a 75 per cent exemption has been given to trailers used as homes.

Taxes had been repealed on structural steel and precast concrete shapes for bridges on public highway systems, chimney caps, circulating pumps for heating of buildings, doors and window screens, and septic tanks. A brief in October had called for expansion of present exemptions for lumber, plumbing, heating and cooling systems, soil and sewer pipe, hardware, bridge materials.

Chairman, J. D. Allan, of the Research and Education Committee, following announcements of awards in the C.C.A. construction thesis competition to R. W. Cockfield, a 1957 graduate of Queen's, and of six prizes to other students, commented that not a single actual application had been made last year for the post graduate fellowship.

The past year had seen actual commencement of the post-graduate course in highway engineering at the University of Alberta. The University of Toronto Extension Department had offered their fifth year course in construction management in the fall of 1957, with enrolment limited to 60. The University of Manitoba and the Winnipeg Builders Exchange had successfully conducted their second series of lectures on work measurement, financing, and managing large projects.

Standard Practices Committee Chairman, A. Burke Doran, pointed out that the many resolutions on tendering practices at C.C.A. conventions, though a healthy sign, showed much remained to be done to bring about satisfactory standard practices. Public tender openings were now universal procedure for federal projects opened in Ottawa with exception of a few 'secret' defence jobs and F.D.C. projects. F.D.C. practice will be reviewed, the prime minister's office had assured. C.M.H.C. did not yet conduct public tender openings but did agree lists of bids would be sent directly after tenders were opened.

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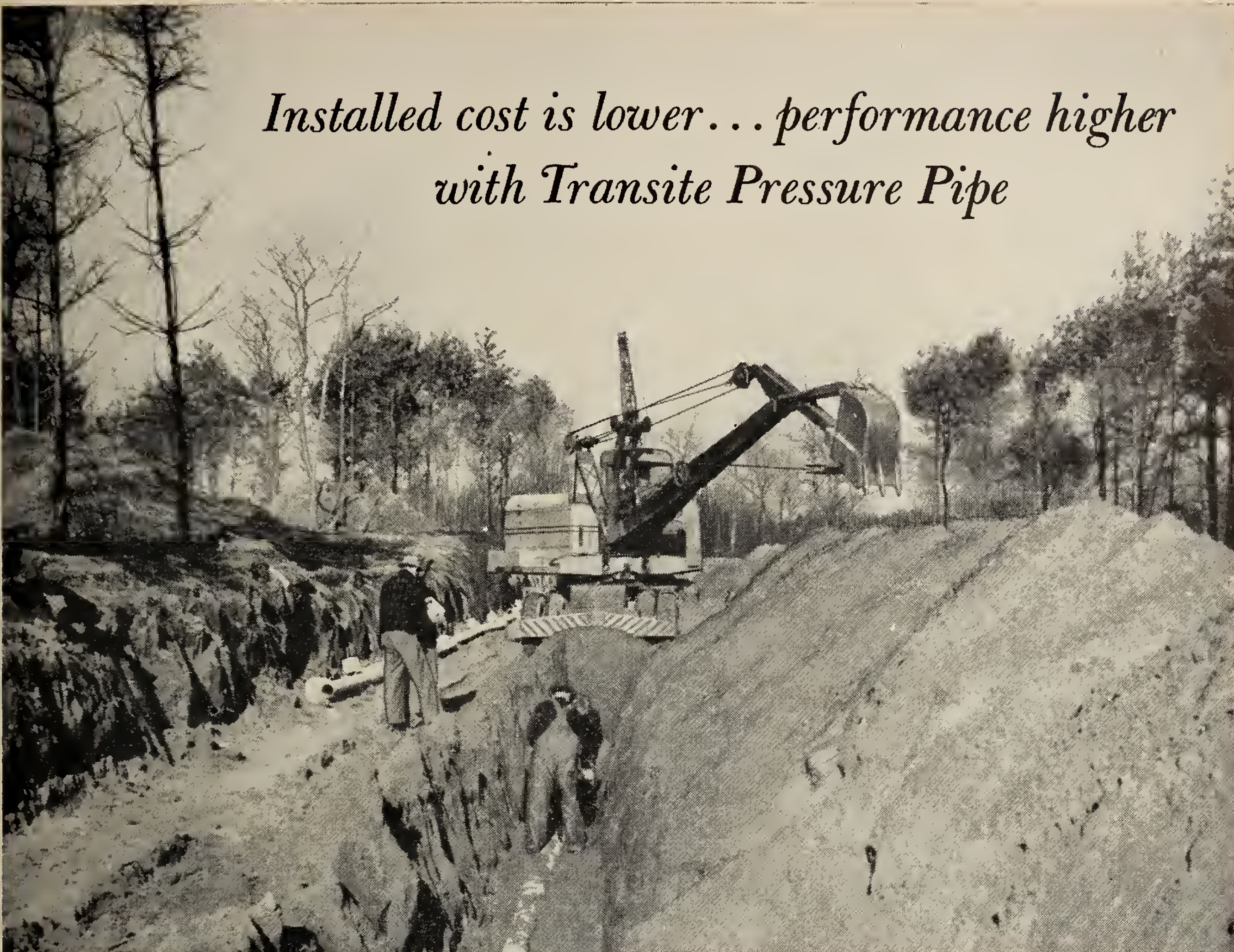

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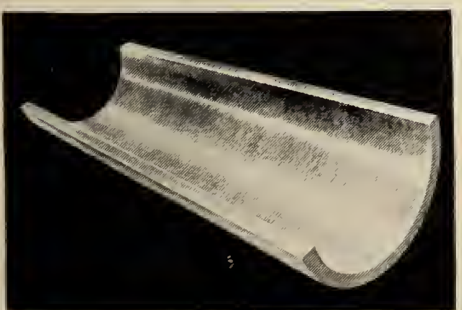

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● OTHER SOCIETIES

It had been gratifying, he said, to note the increasing number of provincial departments and municipal governments conducting openings with bidders present. He appealed to all members to be vigilant for undesirable tendering requirements.

Chairman Raymond Brunet of the National Joint Wintertime Construction Committee told members the percentage of seasonally unemployed workers in the industry had been steadily decreasing, but in mid-winter it was still upwards of 25 per cent of the peak number employed in September.

Today, he pointed out, the number of seasonally unemployed in the industry was at its greatest in many years, yet employment was also at record levels for the time of the year. But the present problem would be much worse without the wintertime construction campaign. The main credit should properly go to the federal Department of Labour for its national publicity program.

A statement by the architectural and engineering professions had been issued with approval of the committee, pointing out the advantages of winter construction, he reported.

President's Address

C.C.A. President, Tullis N. Carter, in his presidential address, told delegates the various forecasts for construction volume predicted a level roughly the same as the record program of some $6.9 billion carried out in 1957. For the first time in some fifteen years, however, volume would be moving sideways rather than upwards. In some sections it would be a matter of expansion, in others one of consolidation, and in still others one of contraction.

Easing of the tightness of money gave promise of larger municipal and housing programs. Recent reduction in N.H.A. financing requirements and a record immigration program would increase demand for housing; more mortgage funds and serviced land would be needed, however. The federal minister of public works had expressed the hope that 140,000 units would be started in 1958.

Defence construction would fall off, without a change in present plans, but the total volume of federal public works projects might increase. Road construction would also increase, said Mr. Carter. Capital expansion for industry and commerce appeared to be dropping, with a marked decrease in large scale engineering projects.

Companies active in export markets and business in general were taking a critical look at the price of new projects, and construction costs must be kept at levels that will continue to attract investors Mr. Carter warned. Pricing of equipment and some materials was also causing concern. It was not entirely coincidental that the high wage areas were among those with a reduction of business or that the president of the A.F.L.-C.I.O. building trades department should advocate a year's stability in wage rates for construction and related industries in the U.S.A.

Capacity had surpassed the demand for construction services. This, he pointed out, would possibly mean the industry would see increased efficiency. It would also mean even keener competition, if that were possible. Owner resistance to higher costs would place a greater strain on committees negotiating with labour unions. If current trends continue, there would likely be less profits and more failures.

Federal taxation statistics for 1955 recently published, had shown 27 per cent of incorporated construction companies operated at a loss. This high percentage of loss was not a healthy sign. Those operating in the building contract field should be especially careful of their bidding in 1958.

"Bid as low as your skill, experience and ingenuity will permit, by all means, but then add an allowance for a profit in keeping with the contribution of your skill, experience and ingenuity," the president advised. These remarks applied equally to road builders. It was a fact that the percentage of loss companies among road and bridge contractors was above the industry's average, he added.

Immigration Needed for Development

With seasonal unemployment and layoffs there was naturally a clamour for public works and curtailment of immigration. The speaker said he has no quarrel with expanded public works programs, provided they were not uneconomical 'make-work' projects but were investments in Canada's future.

But as to suggestions that immigration be cut off virtually to a standstill, he expressed concern about the effect that such policies, designed to meet short-term problems, would have on long term policies designed to expand our economy and improve our living standards. If a country rich in resources wishes to grow, immigration should continue at a high level. The prospects of many of those now unemployed, indeed, might well depend on job opportunities provided by the larger market of a larger population. A levelling off period, coupled with great potential development, was the time to keep immigrants coming in reasonable numbers.

Government Policy on Public Works

The Hon. Howard Green, federal minister of public works, guest speaker at the annual banquet, gave members and delegates a look at the government's intentions respecting public works. There would be greatly expanded dredging taking place. Every year his department spent $175-$200 million on buildings, and it hoped to be building a postal terminal in Quebec at an early date.

Besides a joint-venture bridge at Campbellton to be undertaken soon, investigations were proceeding regarding a causeway to Prince Edward Island. There would be harbour developments at Lakehead, Sault Ste. Marie, Windsor, Toronto, Hamilton and St. John's.

The Federal Government, he said, would be continuing as a partner in highway building. It was interested in developing roads into Northern Canada. Help could and should be given in supplying power to those provinces where such help was needed: thermal plants and power lines in the Maritimes; dams on the Saskatchewan and development of the Columbia; before long there would be tremendous developments on the Yukon river, exclusively within Dominion jurisdiction.

Following government adoption of the Agency Loan Plan almost $200 million had been loaned for small homes and modestly priced apartments. This was a field in which the government was particularly interested, he stated. Great re-development programs would be under way before long.

Defence Construction for 1958

R. G. Johnson, president and general manager, Defence Construction (1951) Ltd. after giving an outline of work accomplished by D.C.L. since its inception seven years ago valued at some $1.2 billion, told the meeting what was planned ahead for 1958 and beyond. New defence work was likely to be awarded close to a value of $100 million compared with awards last year amounting to $58 million. Defence works would be put in place having a value of $65 million, compared with some $100 million in 1957. In addition he estimated an expenditure of a further $58 million on the Northern Ontario Crown Pipeline and some $12-14 million on other non-defence programs such as the Colombo Plan.

Value of work under existing contracts together with projects still to be awarded during the 1957-58. fiscal year totalled nearly $35 million, he stated.

Of this over $24 million represented work already under way. Major projects planned for the near future included the R.C.A.F. station at Summerside, P.E.I., where work would start before summer on hangars and other facilities valued at $8 million. A similar program was planned at Greenwood, N.S.

Cost Price Inflation

Ralph C. Pybus, President, Canadian Chamber of Commerce, and a C.C.A. member from British Columbia, made a stirring appeal for control of the alarming cost price inflation squeeze — before we lose our hard won markets, add to our unemployment, and see the value of our life insurance and pension funds shrink — before it kills the will to save and invest.

The desire for a higher standard of

living was common to us all, he said, but wage rates increasing faster than national productivity unhappily added to cost and to price, with much of the real wage gain lost. From September 1949 to September 1947 the average weekly wage rate had risen 59 per cent, productivity had risen only 43 per cent, while consumer prices had gone up 23 per cent, showing a loss in the value of our dollar. Comparing reports for nine months of 1957 against the same period of 1956 was even more alarming.

"Could we sustain our present living standard", he asked. He was sure we could if some level heads prevailed. He challenged management and business leadership, and union leaders and government leaders too, to face up to this serious problem of cost price inflation. Efficient productivity, he warned, was the key to our continuing prosperity. Labour and management were partners in progress and prosperity, and must share responsibilities as they share the benefits. They must find a way to work together to restrain excessive wage demands and excessive prices.

Canada—U.S. Chemical Engineering Conference

The executive committee of the Canada-U.S. Chemical Engineering Conference has extended an invitation to members of the Engineering Institute to attend the conference to be held at the Sheraton Mount Royal Hotel, Montreal, April 20-23, 1958. Sponsoring societies are the American Institute of Chemical Engineers and the Chemical Institute of Canada, chemical engineering division.

Pre-registration forms and additional information may be obtained from the secretary of the executive committee: Frank Rogers, c/o Shawinigan Chemicals Ltd., P.O. Box 6072, Montreal, Que.

The technical program contains a number of matters of great interest.

Symposia: Chemical Engineering Education in the U.S. and Canada; Statistics in Chemical Engineering; Chemical Engineering Problems in Heavy Water Reactors; Chemical Engineering in Mineral Processing; High Temperature Materials for Jets and Rockets; Fluid Mechanics; Noise in the Chemical Industry; Future Sources of Energy; Chemical Engineering in the Pulp and Paper Industry.

Technical Sessions: The Chemical Industry in Europe Today — three sessions reviewing the situation in the United Kingdom, France, West Germany, and Italy; Modern Engineering Construction Techniques; ten technical papers on other important separate subjects.

Panel Discussions: Relationship Between Investors and Chemical Industry Management; Career Opportunities in Chemical Engineering.

The program also includes a number of plant visits, luncheons with such well known speakers as The Hon. J. Paul Beaulieu, Quebec's Minister of Industry and Commerce, The Hon. Lester B. Pearson, and W. M. V. Ash, president of Shell Oil Company of Canada Ltd. There will be a real French Canadian "Habitant" dinner dance on April 22.

C. A. Peachey, on Engineering Education

The part played by professional engineers in the development of the province of Quebec is an ever-increasing one, C. A. Peachey, president of the Corporation of Professional Engineers of Quebec stated in January.

Mr. Peachey reviewed the situation existing since the appearance of Sputnik, and examined the view that the nation's security is in jeopardy and that a "crash" program is needed to produce more engineers. He said, "We should not hastily assume that Russia is ahead of the western world in basic research. They have demonstrated a very high quality of advanced technology, but there is little evidence that they, any more than the western world, are building up a backlog of basic knowledge on which future developments will depend. It is probably fair to assume that the incentives which they offer to students at the high school level to study science and mathematics, as compared with the Canadian system, will lead to a higher percentage of those who are particularly gifted following such a career."

The president of the Corporation said it might be prudent to assume that unless our system is altered somewhat, Russia may eventually take the lead in basic research; in his opinion emphasis should be placed on science and mathematics in our high schools, with guidance of competent, adequately paid science and mathematics teachers.

"At the top of the scale", said Mr. Peachey, "we have students graduating in engineering, science and mathematics, and immediately moving into industry, because of high starting salaries". He went on to express the opinion that the real shortage in Canada as in the United States, lies "more in men trained to higher than a bachelor's degree, and in men who wish to make a career of moving forward the boundaries of science."

"Since we cannot live forever from our present pool of fundamental scientific knowledge", Mr. Peachey concluded, "we should make it worth while for more gifted students to study towards a higher degree."

Calendar

Chemical Engineering

The next annual meeting of the Chemical Institute of Canada (18 Rideau Street, Ottawa 2, Ont.) is scheduled for Toronto, May 26, 27, 28, 1958.

Welding Conferences

The American Welding Society (33 West 39 St., New York 18, N.Y.) will present a welding conference and show in St. Louis during the week of April 14 to 18. The annual meeting of the Society is part of the program, as well as the Adams Lecture, and 63 technical papers.

The Canadian Council of the International Institute of Welding (7 Pleasant Blvd., Toronto, Ont.) offers information on the annual assembly of the I.I.W., to be held in Vienna, Austria, June 29 to July 6, 1958.

Interested people are invited to obtain as soon as possible enrolment forms and the provisional official program from the national committee concerned.

Fifteen technical commissions will hold meetings on the following subjects: Gas Welding and Allied Processes; Arc Welding; Documentation; Hygiene and Safety; Residual Stresses and Stress Relieving; Pressure Vessels, Boilers and Pipelines; Welding Instruction; Resistance Welding; Testing, Measurement and Control of Welds; Terminology; Standardization; Behaviour of Metals Subjected to Welding; Special Arc Welding Processes; Fatigue Testing; Fundamentals of Design and Fabrication for Welding.

Chemical Engineering

For the twelfth chemical engineering exhibition and congress, scheduled for May 31 to June 8, 1958, at Frankfurt, Germany, a technical program of 232 papers has been arranged under the auspices of societies representing 18 different countries.

Information can be obtained from DECHEMA, Postfach, Frankfurt am Main 7, Germany; or from the American Chemical Society, Chicago Section, 86 East Randolph St., Chicago 1, Ill.

Automatic Control

The University of Michigan, College of Engineering, has announced a summer Intensive Course in Automatic Control, June 16 to 25, 1958.

April 15 is the closing date for registration. Further information may be obtained by writing to Prof. L. L. Rauch, Room 1525 B, East Engineering Building, University of Michigan, Ann Arbor, Mich.

Photogrammetry

The University of Alberta, Department of Extension, is arranging a course in Photogrammetry to take place in Edmonton from April 8 to 12. Registration is limited, and the tuition fee is $40.00. Enquiries should be addressed to the director of the Department of Extension.

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LIBRARY NOTES

ADDITIONS TO THE INSTITUTE LIBRARY • REVIEWS • BOOK NOTES • STANDARDS

BOOK REVIEW

ELECTRICAL ENGINEER'S NOTEBOOK

Frank P. Vaughan, Life Member E.I.C. from St. John, New Brunswick, recently presented his engineer's notebook to the Institute Library.

The notebook contains drawings of electrical apparatus and notes on methods of calculations, accumulated during a long and active career as an electrical engineer. The earliest entry, showing "Station Connections for Two Arc Dynamos", is dated September 18th, 1890.

Sections of the notebook are devoted to "Railway Apparatus" and to "Light and Power Apparatus". These are illustrated by drawings on linen of some of the equipment in use before the turn of the century. The section on light and power contains drawings of series street-light installations, two-phase and three-phase transformer connections, and other equipment. There are interesting notes on pole line construction, including a table showing the number of men required to set poles of different lengths and whether pike poles or derricks were needed.

Another section of the book is devoted to radio circuitry. Mr. Vaughan was one of the pioneers of radiotelephone communication. One of the notes mentions that he talked with Partridge Island by Radio Telephone from his residence in St. John in 1906. In 1912, he obtained one of the first ten radio experimental licences granted in Canada. Another note records that "the first broadcasting station in New Brunswick, designed and built by Frank P. Vaughan, went on the air in June, 1922." There are circuit diagrams of transmitter and receiver components.

Mr. Vaughan is an amateur artist of considerable talent, as shown by his paintings of birds which adorn the walls at headquarters. His notebook indicates his proficiency as a penman, including many pages done in flowing script with shaded pen-strokes.

BOOK NOTES

Prepared by the Library, The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

*ACI MANUAL OF CONCRETE INSPECTION 4TH ED.

Describes methods of inspecting concrete construction generally accepted as good practice. This manual supplements the specifications of a job and provides guidance in areas not covered by specifications. Areas included are the inspector, proportioning of mixes, inspection and testing of materials, inspection before, during, and after concreting, testing of concrete, and records and reports. Special features are a list of standard specifications and test methods, and a checklist of inspection. It is intended to be useful not only to inspectors but to engineers and contractors as well. (Detroit, American Concrete Institute, 1957. 240p., $3.50.)

*ATOMIC POWER, AN APPRAISAL

The contents of this volume are based on an informal panel discussion held by the International Bank for Reconstruction and Development. The participants, all leading world figures in atomic energy development, present a picture of the present and future potentialities of nuclear power in economic terms and its probable impact upon individuals and nations. To provide an introductory framework, the volume begins with a series of chapters devoted to the atom, atomic energy, radioisotopes, and related subjects.

Those taking part in the discussion included Sir John Cockcroft and Sir Eugene Plowden from the United Kingdom A.E.A., the Hon. Lewis L. Strauss and W. Kenneth Davis of the United States A.E.C., Francis Perrin of the French National Atomic Energy Commission, and the Hon. Antonio Carrillo Flores and Eugene R. Black of the World Bank. This is the first of a series of monographs on the economic aspects of nuclear energy. (Ed. by Corbin Allardice. New York, Pergamon, 1957. 151p., $3.50.)

*CONTROL VALVES

The author furnishes descriptions of the variety of automatic control valves and actuators available for use by the instrument engineer or plant operator. Considerable emphasis is placed upon the actuator since, in addition to its use with the control valve body, it has wide application for positioning other pieces of equipment. Aspects of control valves included are capacity, flow characteristics and mechanical features, and selection. Actuators discussed are the pneumatic, solenoid and motor, and combination types. The articles were first published serially in Instruments and Automation. (C. S. Beard. Pittsburgh, Instruments Publishing Co., 1957. 222p., $2.00.)

CREEP AND RECOVERY

The fourteen papers in this volume were presented at a seminar held at

THE ENGINEERING INSTITUTE LIBRARY

The publications mentioned in these Notes are now available in the Library. Members of the Institute may borrow books, periodicals, pamphlets, etc. from the Library. The loan period is two weeks, excluding time in transit, and two items may be borrowed at one time. Library hours are: Monday to Friday: 9 a.m. — 5 p.m.; Saturday, 9 a.m. — 12 noon.

Because of a recent change in policy, publications (except periodicals published by other engineering societies) may no longer be purchased through the Library. If members have difficulty obtaining material locally, it is suggested they write to the Library, and the enquiry will be forwarded to an appropriate bookseller. For further information write to the Librarian.

• LIBRARY NOTES

Cleveland during the thirty-eighth National Metal Congress in 1956. The first group of papers is concerned with various aspects of recovery, thermodynamics, defects, and the recovery of various physical and mechanical properties including polygonization and the mechanism of annealing in neutron irradiated metals.

The second group deals with the interaction of dislocations and vacancies and grain boundary behaviour in creep of crystalline metals. The last paper discusses the creep of crystalline non-metals. The value of the book is increased by the detailed subject index and the bibliographies included with each paper giving a total of 570 references. (Cleveland, American Society for Metals, 1957. 372p., $7.50.)

DISLOCATIONS AND MECHANICAL PROPERTIES OF CRYSTALS

This report of an international conference held at Lake Placid in 1956 presents a comprehensive, up-to-date account of the subject by fifty-four of the world's authorities, and includes the papers presented at the conference and the discussions they provoked, both oral and written.

The papers are divided into eight sections: direct observations of dislocations; deformation of pure single crystals; work hardening and recovery; alloy crystals, impurities and yield point phenomena; dislocation damping and fatigue; theory of dislocations; whiskers and thin crystals; radiation damage.

The conference was sponsored by the U.S. Air Force Office of Scientific Research, Air Research and Development Command, and the General Electric Research Laboratory. (Ed. by J. C. Fisher and others. New York, Wiley, 1957. 634p., $15.00.)

*EDUCATION FOR PLANNING: CITY, STATE AND REGIONAL

With rapid urbanization, the spread of industry, and pressures on water, land, and energy resources in various parts of the country there has come about an increased need for formal planning activities. The question of what constitutes an appropriate basis for the education of city and regional planners is raised in this book and an attempt is made at some tentative answers. The three essays included deal with these topics and in addition review University of Chicago experiments in these areas. (H. S. Perloff. Baltimore, Johns Hopkins Press, 1957. 189p., $3.50.)

*ELECTRONIC DESIGNERS' HANDBOOK

Design data and fundamental information on electronics are presented in this handbook with somewhat more than usual attention to theoretical explanations, which are supplemented by design examples. Areas covered include vacuum tube fundamentals, computer and servomechanism techniques, and waveform and network analysis. In addition attention is given to such rapidly developing fields as transistor fundamentals and circuit design, design of stabilized d-c amplifiers, and advanced regulated power supply design. There is an unusually thorough section devoted to receivers. (R. W. Landee, D. C. Davis and A. P. Albrecht. Toronto, McGraw-Hill, 1957. Various paging, $16.50.)

*ELEMENTARE SCHALENSTATIK, 2ND ED.

An introductory treatise on the statics of shells. Originally published as a textbook, the new edition has been enlarged and revised so as to be useful to the practicing engineer as well. After a brief explanation of the shell concept, the author discusses in detail the membrane theory of rotation shells, the bending theory of rotation shells, and, specifically, the membrane theory of cylindrical shells. There are also notes on the states of stress and a tabular summary of membrane theory solutions for shells of various forms. (A. Pfluger. Berlin, Springer Verlag, 1957. 112p., DM 19.50.)

ELEMENTS OF CLASSICAL THERMODYNAMICS

Intended primarily for advanced students of physics, this short account of the fundamental ideas of classical thermodynamics will also be of interest to research workers in chemistry and engineering. It develops the subject from the postulated laws of thermodynamics to conclusions which can be reached without using advanced mathematics.

The first and second laws of thermodynamics are discussed in the first five chapters, and succeeding chapters show how they can be applied to correlating the properties of simple systems, especially fluids and magnetic substances. The law of increase of entropy is analyzed, and applied to problems of phase equilibrium and higher order transitions.

Problems, illustrative examples and bibliographic footnotes are included, but details of experimental methods have been excluded. (A. B. Pippard. Cambridge, University Press, Toronto, Macmillan, 1957. 165p., $4.25.)

*FLUGLEHRE

Originally intended for pilot training, this introductory text on the theory and design of airplanes covers the following topics: general data on air forces and air resistance; wing structures; motorless flight; the propeller; the power plant; airplane performance; controls and stability; take-off and landing; helicopters; navigation and transportation. (R. von Hises. Sixth edition revised by Kurt Hohenemser. Berlin, Springer Verlag, 1957. 402p., DM 25.50.)

FLUID MECHANICS FOR ENGINEERS

An undergraduate textbook which emphasises the fundamentals of fluid mechanics, this book includes many worked examples to illustrate the theories presented, and will be equally useful to students in Mechanical and Civil Engineering.

The first part deals with fluid statics, perfect and viscous fluids in motion, flow in closed conduits and open channels, fluid metering, dimensional analysis of fluid flow phenomena, boundary layer theory and the elements of wing theory. Part two is concerned with the fundamentals of the flow of compressible fluids, whilst part three covers centrifugal pumps and fans, axial flow pumps and fans and hydraulic turbines. (P. S. Barna. Toronto, Butterworth, 1957. 377p., $11.50.)

GEOLOGY AND ECONOMIC MINERALS OF CANADA, 4TH ED.

Since the third edition of this book was published in 1947 Canada's mineral production has more than trebled. The major changes have come from oil and gas production, but there have also been spectacular developments of uranium deposits, and developments in base metals, iron ore, lithium and asbestos. Advances in air transportation have made possible increased geological exploration and mineral discovery in remote areas.

The various chapters are written by members of the Geological Survey of Canada who are experts in their special fields, and the material is arranged according to geological province: Canadian Shield; Appalachian region; St. Lawrence and Hudson Bay Lowlands, and Palaeozoic outliers; the Interior Plains; and the Cordilleran region. There is a useful new chapter on the geology of the Arctic Archipelago, and a final chapter on Pleistocene geology and surficial deposits.

The book is illustrated by many photographs, tables and line drawings, and recent geological maps and charts are included in an inside cover pocket. There are also lists of references for further reading. (Ed. by C. H. Stockwell. Ottawa, Queen's Printer, 1957. 517p., $2.00. Geological Survey of Canada, Economic Research Series No. 1.)

HANDBOOK OF CHEMISTRY AND PHYSICS

This latest edition of a well-known, standard handbook contains material on all branches of chemistry and physics and closely related sciences which are likely to be used frequently. The material is largely in tabular form, and is divided into five sections: mathematical tables; properties and physical constants; general chemical tables and tables of specific gravity and properties of matter; heat, hygrometry, sound, electricity and magnetism, and light; quantities and units.

New tables in this edition include those for nuclear spin and moments; relative sensitivities; superconductivity of some metals, alloys and compounds; energy, mass and velocity relations for the electron; magnetic properties of certain transformer steels and high perme-

ability materials. The table of isotopes has been extended and revised, and the transuranium elements through element 101 added. New tables have also been added containing the dielectric constants and dipole moments of substances in the gaseous state.

The volume is clearly printed on india paper, and remains a convenient size in spite of its large number of pages. (Ed. by C. D. Hodgman. Cleveland, Chemical Rubber Pub. Co., Toronto, Ambassador, 1957. 3213p., $12.50.)

HEAT

One of the Basic Science Series issued by Rider, this volume by the Chairman of the Physics Department of a New York High School takes a new approach to the subject by including the coverage of modern heat engines and the thermodynamics needed to understand their operation.

The first chapter explains the difference between heat and temperature, and also covers thermometry and the expansion and contraction of solids, liquids and gases. The second and third chapters deal with heat measurement and transfer. The final two chapters cover the change of state and heat engines, including steam turbines, gas and diesel engines, turboprops, ramjets, rockets and reciprocating steam engines. (Alexander Efron. New York, Rider, Toronto, Pointon, 1957. 105p., $1.50.)

*HEAT TRANSFER, VOLUME II

A direct continuation of volume one, this volume consists of three sections: heat radiation in spaces of simple configuration, selected fields of application, and supplements to volume one. The largest portion of the book consists of specific applications such as heat transfer in thermometry, recuperators, regenerators, cooling towers, cooling of surfaces exposed to hot gases, heat transfer through laminar boundary layer at high fluid velocity, and heat transfer in liquid metals. The concluding section brings the material in volume one up to date. (M. Jakob. New York, Wiley, 1957. 652p., $15.00.)

HIGH-TALENT MANPOWER FOR SCIENCE AND INDUSTRY

That the development of high-talent manpower for science and industry is of critical importance is today widely recognized.

In the two essays of which this volume is composed, the authors emphasize that it is the men of high-talent, the "seed-corn" human resources as they call them, who are the initiators of change and progress in both the industrialized and underdeveloped countries, and that this talent cannot be mass-produced but must be carefully developed.

The first essay discusses the United States and the role which should be played by corporations, universities and the government in developing the creative scientist, the research engineer and the outstanding administrator.

The second essay examines the needs of the less developed countries for the high-talent manpower which will transform an agrarian to an industrial society, and concludes that the creation of this manpower must take precedence over an attempt to provide general education for the masses.

This is a most timely and thought-provoking book. (J. D. Brown and Frederick Harbison. Princeton, University Industrial Relations Section, 1957. 97p., $3.00.)

*A HISTORY OF TECHNOLOGY, V. 3—FROM THE RENAISSANCE TO THE INDUSTRIAL REVOLUTION

This is the third of a five-volume history which will cover the subject from the Old Stone Age to the later nineteenth century. The present volume gives due attention to the pendulum clock, inquiries into the properties of metals, and to improvements in scientific instruments — developments of significance for future centuries — as well as to the great wooden ships, huge machines for raising water, and massive stone buildings that were the culmination of long technological traditions. Like others in the series the volume is superbly printed and illustrated. (Ed. by Charles Singer and others. Toronto, Oxford University Press, 1957. 766p., $25.50.)

HOW TO READ SCHEMATIC DIAGRAMS

Intended for students, technicians and those who have no prior knowledge of electricity or electronics, this book explains the basic theory of the subject, symbolism, technical notations and the organization of schematics in pictorial form.

The various chapters cover electrical and electronic symbols and diagrams used for direct-current circuits; alternating-current circuits; electronic equipment power supply circuits; audio amplifier circuits. The final chapter discusses the reading and interpretation of complex and complete schematic diagrams, using radio and television circuits as examples. (David Mark. New York, Rider, Toronto, Pointon, 1957. 147p., $3.50.)

INDETERMINATE STRUCTURAL ANALYSIS

A knowledge of determinate structural analysis is expected of the reader of this introductory volume written for both the student and practicing structural engineer or architect.

The first chapter contains a brief history of the development of structural theory, while the next three chapters discuss the theories on which the book is based, the stability and determinateness of structures, various basic concepts, and the methods for computing deflections.

In chapters five to thirteen there are detailed discussions of the methods used in the analysis of indeterminate structures, together with examples of their use. These include Maxwell's method as modified by Mohr and Müller-Breslau, the method of least work, the column analogy, moment distribution, the slope-deflection method, influence lines and elastic arches.

The final chapter on model analysis of structures is based on the author's experience in developing the structural model laboratories at Rensselaer Polytechnic Institute, and includes the basic principles and methods of direct and indirect structural model analysis.

Many problems and references for further reading are included throughout.

An abridged edition of this work has also been published, and is intended for use as a textbook for a one-semester course. It includes chapters 1-7 of the complete edition, and the greater part of chapters 8, 11 and 12. (J. S. Kinney. Reading, Addison-Wesley, 1957. 655p., $9.50. Abridged ed. 352p., $7.50.)

MECHANICAL VIBRATIONS

Based on courses given at New York University, and the author's earlier Elementary Mechanical Vibrations, this book presents the basic principles of vibration analysis through the application of which many of the vibration problems arising in design can be dealt with or avoided. The author does not cover the more complicated problems, but the principles he gives can be used as a foundation for further study of such topics as self-excited vibrations, non-linear systems, damping in systems with more than one degree of freedom, etc.

In this edition greater emphasis has been placed on vector methods and the use of complex numbers. The chapters cover undamped and damped free vibrations and forced vibrations with a single degree of freedom; two degrees of freedom; multimass and equivalent torsional systems; multimass transverse systems; balancing; electrical analogies. Individual topics covered include forced vibrations of multimass systems; harmonic analysis; torsional critical speeds; coupling action; the balancing of angle or vee engines. (A. H. Church. New York, Wiley, 1957. 275 p., $6.75.)

METAL STATISTICS, 1947-1956

The statistical tables on aluminum, lead, copper, zinc, tin, cadmium, magnesium, nickel, mercury and silver in this forty-fourth annual edition cover for the most part the years 1947-1956.

The larger part of the book is devoted to a survey, by country, of each metal, giving detailed statistics on production, exports, imports, manufacture, etc. Other tables show world production, mine and smelter production, and consumption of the metals, and the metals recovered from scrap. (Frankfurt, Metallgesellschaft, 1957. 234p.)

*NUCLEAR CHEMICAL ENGINEERING

This volume describes the materials of importance in nuclear reactors and the processes which have been developed to concentrate, purify, and separate

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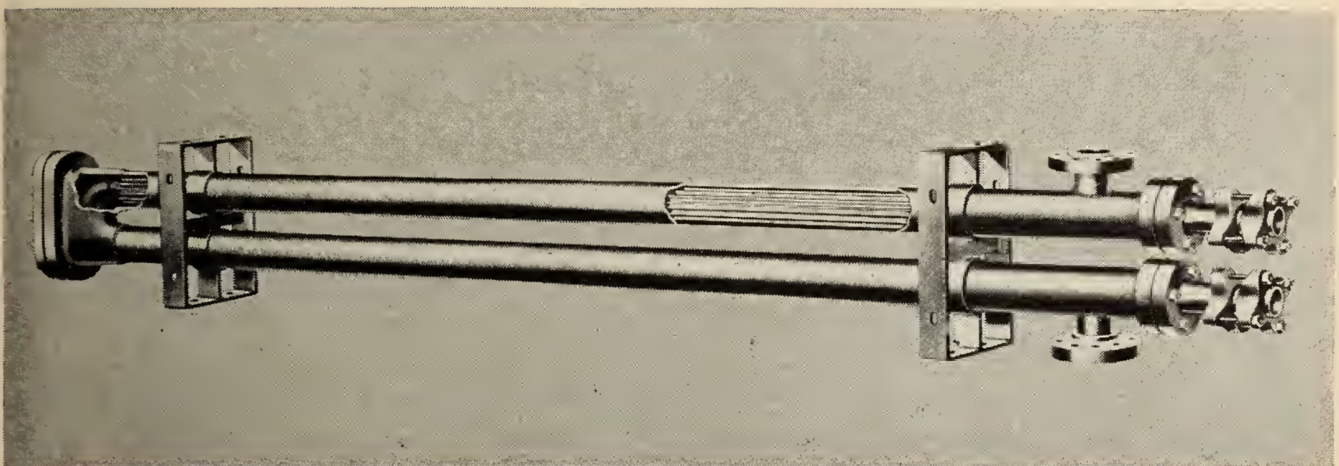

Cutaway view of a Brown Fintube Sectional Hairpin Heat Exchanger, especially designed for high-pressure operations.

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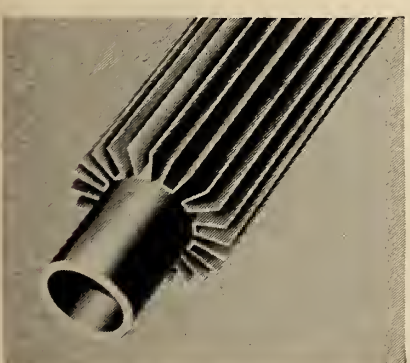

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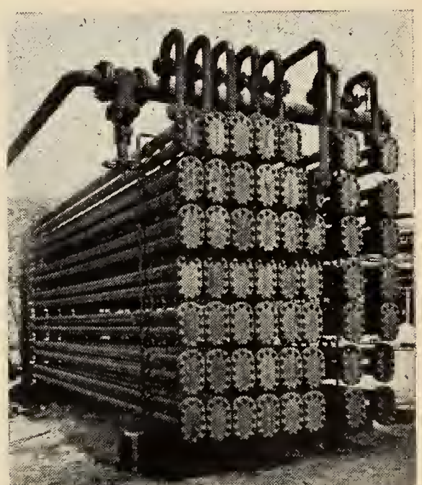

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these materials. After two introductory chapters the following topics are considered: fuel cycles in thermal nuclear reactors; production of uranium feed materials; solvent extraction of metals; properties of irradiated fuels; separation of reactor products; principles and methods of isotope separation for both light and heavy elements. References for further reading, and problems are given at the end of each chapter. (M. Benedict and T. H. Pigford. Toronto, McGraw-Hill, 1957. 594p., $10.95.)

*NUCLEAR POWER REACTORS

Selected and arranged information from the papers at the Geneva Conference. After a discussion of the present outlook for heavy power production from nuclear sources the book covers basic facts on reactor design and construction and a comparison of various types as power producers. An extensive chapter is devoted to economic considerations, and detailed studies are presented of the different types of reactors. (Ed. by J. K. Pickard. Toronto, Van Nostrand, 1957. 388p., $9.25.)

ON THE OLD LINES

Sub-titled "Locomotives round the world", this is the author's personal record of the trains he has seen in thirty-seven countries, and it is written for all those who are fascinated by locomotives, and by steam engines in particular. To the author, the diesel "just isn't an engine any more."

According to Mr. Allen, this is just a picture book with lengthy captions, which often are a full page, a look through his photograph album, for he has personally taken all the many photographs in the book.

Continental Europe, the Near East, North and South America, Australasia and the East, all are represented in this fascinating book. Narrow-gauge, wide-gauge, coal burning, wood-burning, the Canadian Rockies, the Australian plains, freight and passenger, the old and new, Mr. Allen is interested in them all, and his reader cannot fail but be interested too in this type of locomotive which seems doomed to eventual extinction. (P.C. Allen. London, Cleaver-Hume, 1957. 185p., 25/-.)

PHYSICO-CHEMICAL EFFECTS OF PRESSURE

This survey of the effects of high pressure in the field of physical chemistry will be of interest to both physicists and chemists and to chemical engineers wanting to exploit these effects. Most of the book is concerned with changes brought about by pressures over a hundred atmospheres, but some data on lower pressure is included where the experimental pressure range was restricted or where the effects were unusually large.

Topics covered include: technique of high pressure experiments; volumetric effects of pressure; changes of phase under pressure; transport properties and the velocity of sound; dielectric and optical effects; electrolytic conduction; equilibria in and the kinetics of chemical reactions under pressure; and miscellaneous effects of pressure. (S. D. Hamann, Toronto, Butterworth, 1957. 246p., $8.50.)

*PRINCIPLES OF THE PROPERTIES OF MATERIALS

A study of the properties of materials which utilizes a new approach by emphasizing principles and properties rather than treating materials separately. The properties dealt with in separate chapters are conductivity, heating, diffusivity, electrochemistry, elasticity, plasticity, fracture, viscosity, and general considerations of crystallinity. An introductory section on physico-chemical foundations deals with atoms, equilibrium, structure, cohesion, and the electron theory of metals. (J. P. Frankel. Toronto, McGraw-Hill, 1957. 228p., $6.90.)

*PROCESS INSTRUMENTS AND CONTROLS HANDBOOK

A thorough and systematic treatment of the operating and design fundamentals of measurement and automatic control systems used in the process fields. Although specifically slanted toward the process industries, the fundamental techniques described are applicable to non-process fields such as medical, military and aircraft instrumentation. Among areas covered are measurement standards, primary elements, measurement systems, indicators and recorders, automatic controllers, electric and pneumatic telemetering, fundamental principles of process control, and mathematical techniques for solving automatic control problems. (Ed. by D. M. Considine. Toronto, McGraw-Hill, 1957. Various paging, $22.45.)

*RAFT FOUNDATIONS: THE SOIL-LINE METHOD OF DESIGN

This volume is planned to give engineers a method of raft design that takes into account variations in soil pressure. Recent advances have provided more information concerning means of arriving at the value of the modulus of elasticity of the soil, which in turn has given more precision to the use of this method. Present methods of raft design are discussed and followed by a detailed analysis of the soil line method. The conclusion then deals with examples of the applications of this method and with determination of the coefficient of subgrade reaction. (A. L. L. Baker. London, Concrete Publications, 1957. 148p., $2.80.)

*REFRIGERATION, AIR CONDITIONING, AND COLD STORAGE

A comprehensive text for engineers, technicians, and students, presenting in clear language with numerous illustrations the principles of refrigeration and allied subjects. Beginning with the required physics, the book takes up in order refrigerants, the mechanical refrigeration cycle, equipment, controls, and the application, operation, and maintenance of the refrigeration system. Brines, cold storage, lubrication, and air conditioning are treated in separate chapters. (R. C. Gunther. Philadelphia, Chilton, Montreal, Wallace, 1957. 1232p., $17.50.)

*SAFETY ASPECTS OF NUCLEAR REACTORS

Composed of key papers from the Geneva Conference on the Peaceful Uses of Atomic Energy, the material has been carefully selected, edited, and grouped under the following headings: normal reactor and chemical plant operations; development of radiation safety criteria; reactor accidents and their consequences; super-critical reactor experience. Since little has been available on the subject, this is a useful contribution in an area that will assume more importance as the power reactor program is developed. (Ed. by C. R. McCullough. Toronto, Van Nostrand, 1957. 237p., $8.50.)

SOUND

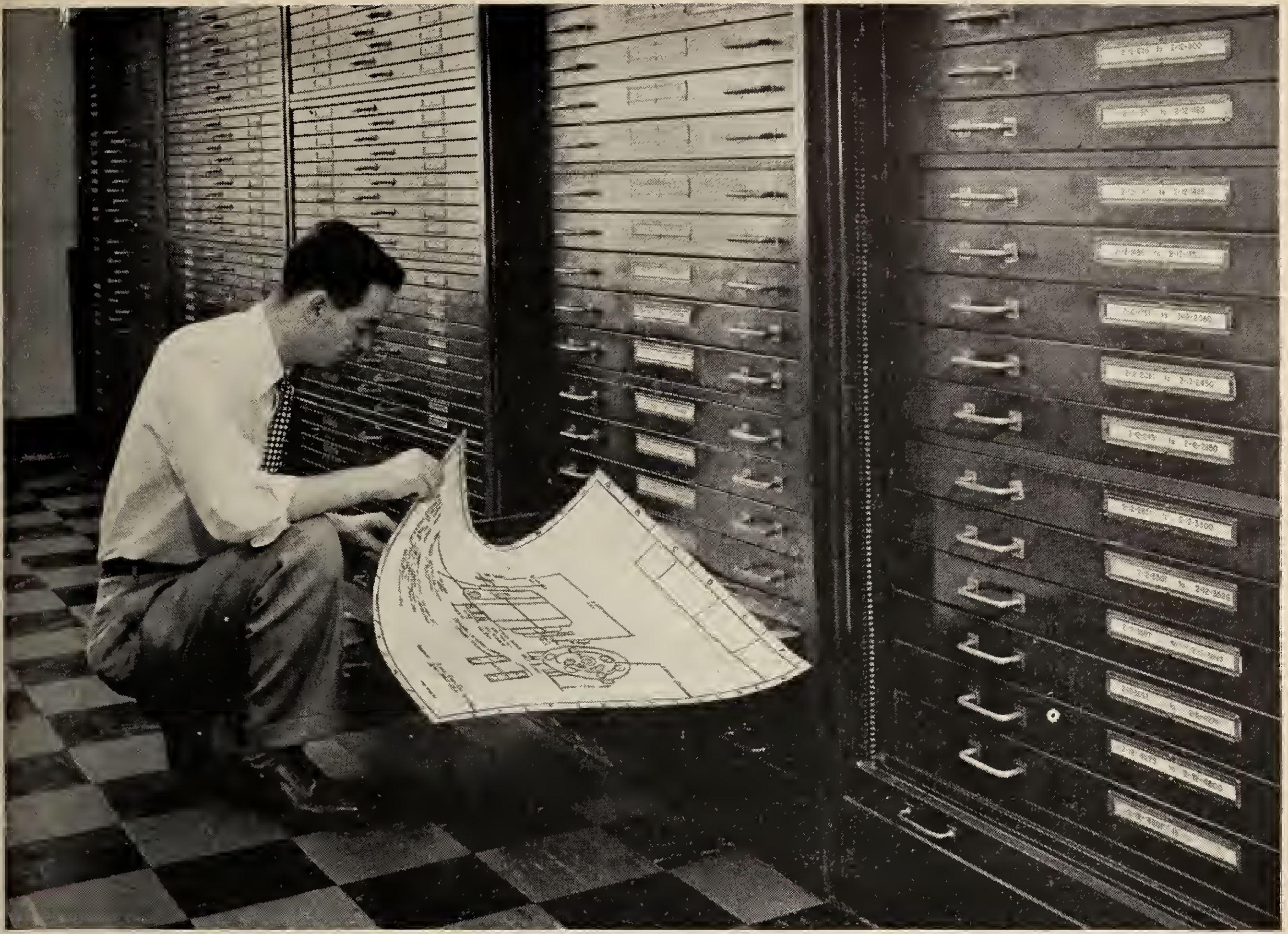
Another in the series of the Basic Science Books being published by Rider, this volume contains an introductory outline of the subject. The first chapter considers the physical aspects of sound, its mode of production and propagation, the nature of the vibratory process, and the properties of audible vibrations. The second chapter deals with hearing, speech and music, and the last chapter considers sound waves in detail. (Alexander Efron. New York, Rider, Toronto, Pointon, 1957. 72p., $1.25.)

STATICALLY-INDETERMINATE STRUCTURES, 3RD ED.

The first edition of this work was published in 1944, the main change in this edition being the inclusion of a chapter on the "plastic hinge" method of designing reinforced concrete frames. Additions have been made to the chapter on curved beams, and the section on distribution methods (Hardy-Cross) revised and enlarged. The chapter on elasticity equations with only one unknown in each equation has been omitted, as the plastic method simplifies the calculation of the simultaneous equations by giving the designer an opportunity of choosing a range of values. (R. Gartner. London, Concrete Publications, 1958. 126p., $4.00.)

SURVEY OF MINES 1958

In 1957 Canada's mining industry was in a consolidating position as the general demand for minerals decreased, but continued industrialization throughout the world is expected to lead to an ever increasing demand for essential materials. Increasing quantities of uranium are being produced, as are other atomic energy age minerals such as lithium,



columbium, molybdenum and beryllium, and industrial minerals like sulphur and feldspar.

This survey gives detailed information on all Canadian mining companies including production, earnings, dividends, ore reserves, directors and significant mining property development. There are 26 pages of maps showing the producing companies and developers, and the tables included cover statistics of mineral production, dividends paid by mining companies, and price ranges of stocks from 1950 to 1957. (Toronto, Financial Post, 1957. 388p., $3.00.)

UNDERGROUND SYSTEMS REFERENCE BOOK

The first revision of a work originally published in 1931, this volume is a comprehensive and practical study of the best practices in the design, construction, operation, and maintenance, of power cable systems. Its fifteen chapters prepared by a staff of 134 engineers cover thoroughly cable and cable insulation; bulk power systems; underground radial and loop systems; street lighting systems; cable joints and terminations; testing and fault location; corrosion; safety; and related subjects. A detailed subject index is included. (Transmission and Distribution Committee of the Edison Electric Institute. New York, Edison Electric Institute, 1957. Various paging, $13.50.)

VISCOUS FLOW THEORY, VOLUME II: TURBULENT FLOW

This second part of a two volume work on viscous flow deals with the fluid dynamics of turbulence. Two different approaches to the study of turbulent flow are used: the semi-empirical or phenomenological theory of both incompressible and compressible fluids, and the statistical theory. Such topics as probability distribution, random walk, correlation tensor, spectrum, and their relations to turbulence are discussed. Also covered are turbulent diffusion, locally isotropic and non-isotropic turbulence, and turbulence in a compressible fluid flow and in magnetohydrodynamics. (Shih-I Pai. Toronto, Van Nostrand, 1957. 277p., $7.25.)

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Building Research

Ten years of building research 1947-1957. National Research Council of Canada, Division of Building Research, Ottawa, 1957. $1.00.

Directories

The Engineer Buyers Guide 1958. The Engineer, Lond., 1957. 7/6.

British Chemical Plant 1957. British Chemical Plant Manufacturers Association, Lond., 1957.

Geology

Coaticook-Malvina area, by H. C. Cook Quebec. Geological Surveys, 1957. (Geological Report 69)

Description of mining properties visited during 1956 in the Chibougamau region by J. R. Assad. Quebec, Dept. of Mines 1957. (P.R. no. 352)

Preliminary report on Lois Lake area by B. Lee. Quebec, Dept. of Mines, 1957 (P.R. no. 353)

Industry

Ergonomics; human factors in work machine control and equipment design v.1, no.1, Nov. 1957. Taylor & Francis, Lond.

Industrial Property Quarterly. No. 4 July, 1957. International Bureau for the Protection of Industrial Property. Berne.

Meteorology

Climatological summary, Mould Bay N.W.T., Canada, May 1948-Dec. 1953. Dept of Transport, Meteorological Div., Toronto, 1957.

Seismology

Earthquake resistant design; a selected bibiography. American Institute of Steel Construction. 1957.

Steel

Bibliography on deoxidation of steel with author index; 1920-1957. Canada, Dept. of Mines. Ottawa, 1957.

Traffic Engineering

Concrete pavement construction and winter construction of bridges. (Highway Research Board Bulletin 162 U.S., Highway Research Board, 1957).

Proceedings 10th annual Northwest traffic engineering conference. Seattle Univ. of Washington, 1957.

X-Rays

Questions and answers on x-ray diffractometry and spectrography. Philips Electronics, Mount Vernon, N.Y.

Annual Reports

Alberta. Department of lands and forests, 1957. Edmonton, Queen's Printer.

Canada. Department of Northern affairs and national resources, 1956-1957 Ottawa.

Canada. 1957 review of the National Research Council. Ottawa, $0.75.

U.S. Annual report of the Board of regents of the Smithsonian Institute, 1956 Washington, G.P.O., 1957. $4.50.

Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

Ludlow Valve Company — D. D. Ackerman has been elected president and a director of the Ludlow Valve Manufacturing Company Inc., Troy, N.Y., and its Canadian subsidiary Canadian Ludlow Valve Manufacturing Co., Ltd.

International Nickel — It has been announced that L. H. Cooper of London, England, vice-president of The International Nickel Company of Canada, Limited, has been elected a director of the company; Mr. Cooper is chairman of Inco's United Kingdom affiliate, The Mond Nickel Company, Limited. Also announced is the appointment of S. H. Ward to the staff of the Canadian development and research division of The International Nickel Company of Canada, Limited.

Dominion Engineering — J. Jeffrey has been appointed vice-president, administration, of Dominion Engineering Works Limited.

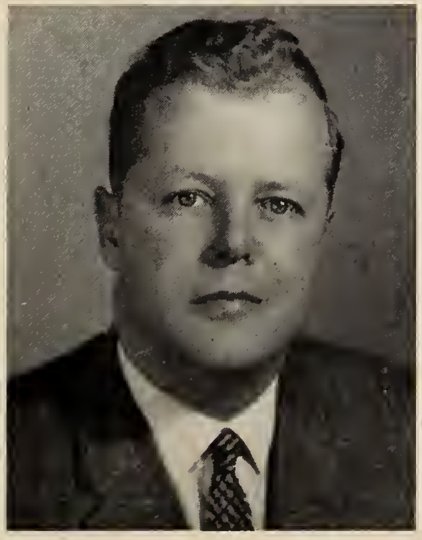
J. Jeffrey

Shell Oil Company — The appointment of D. B. Vale as executive vice-president of Shell Oil Company of Canada, Limited has been announced.

Atlas Copco — Announced recently was the appointment of J. A. Perham as resident director in the United States of Atlas Copco Eastern and Atlas Copco Pacific.

Rolls-Royce of Canada — The appointment of A. J. Geraghty as United Kingdom liaison engineer of Rolls-Royce of Canada Limited, Montreal, has been announced. Mr. Geraghty, recently retired from the Royal Canadian Navy, Air Branch, will remain at the Montreal plant until the spring; he will then be transferred to Rolls-Royce Limited, Derby, England, to replace W. Skelding as Canadian liaison engineer; Mr. Skelding will subsequently return to Rolls-Royce of Canada Limited for company duties in North America.

A. J. Geraghty



J. A. Perham

Canada Wire and Cable — The appointment has been announced of N. R. Spencer as western regional engineer of Canada Wire and Cable Company, Limited. Mr. Spencer will be located at the Vancouver sales office of the company at 1494 Powell Street, Vancouver.

B. F. Goodrich — The following appointments have been announced by B. G. Goodrich: K. Zettel, Toronto district manager, industrial products division; J. Warrell, general supervisor, industrial products division, Toronto district; L. Ratz, supervisor, moulded and extruded sales, industrial products division; R. Schnarr, manager, industrial products development and construction. G. L. Callfas, of Kitchener, has been appointed sales representative for the international B. F. Goodrich company industrial products division at Venezuela, South America.

General Motors Diesel — J. Depuydt has been made district service manager for the Maritimes, eastern Quebec and Newfoundland, for General Motors Diesel Limited, London, Ontario.

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Canadian General Electric—The following appointments in the company's wholesale department were announced recently by Canadian General Electric Company Limited: A. M. Hurley, manager of the newly formed Alberta district, with headquarters at Calgary; B. W. Donaldson, manager, mid-west district, with headquarters at Winnipeg.

Bakelite Company — J. F. Goudey has joined the marketing and development group staff of Bakelite Company, division of Union Carbide Canada Limited, Belleville, Ontario.

American-Standard Products — Recent appointments announced by American-Standard Products (Canada) Ltd. are as follows: R. Cheshire, resident salesman of plumbing products in southwestern Ontario; I. McKellar, sales representative of wet heat products in eastern and northern Ontario and warm air products in northern Ontario only; P. Rogers, sales representative, specializing in plumbing products in northern and eastern Ontario.

New Equipment

Centrifugal Fans — A new series of all-purpose centrifugal fans with airfoil blading has been announced by the B. F. Sturtevant Co. of Canada Limited. Since 1950, the airfoil construction has been applied by Sturtevant to its larger, heavy-duty type of fans for power generation and vehicular tunnel applications. After a record of superior performance had been established in these applications, Sturtevant decided to supersede its present line of flat-bladed fans with the new airfoil construction.

The complete line (series 8000) will therefore bring airfoil centrifugal fans in an effective range of applications including building ventilation, general air supply and exhaust, conventional and high-pressure air conditioning, industrial processing, tunnel and combustion air supply.

Speed Deviation Recorder — A speed deviation recorder with an accuracy to one-tenth of one per cent has been announced by Canadian General Electric Company Limited. The Type HE speed deviation round chart recorder is designed for use in processes where it is necessary to maintain constant speed. An example is in the manufacture of nylon or other man-made fibers, with similar applications in the steel, rubber, paper and chemical industries.

The instrument indicates and records per cent deviation from a predetermined but adjustable speed. Input signal is received from a precision d-c tachometer generator and compared with a stable adjustable d-c reference.

News of Business and Industry

After the proper "set speed" is determined, the speed deviation recorder will indicate and record — in per cent — any deviation from the set speed and show the deviation in a highly expanded chart and scale. Deviations as slight as .01 per cent can easily be read.

Crawler Equipment — A new series of crawler equipment for shaft and tunnel excavation consisting of an overhead shovel loader, a bulldozer and a utility tractor has been announced by the Joy Manufacturing Company (Canada) Limited. Called the JSL-7 Shovel Loader, JMD-7 Mining Dozer and JMT-7 Mining Tractor, the machines come with either air or electric drive. With separate motors and independent track control for each track, one track can run forward and the other reverse to permit gradual or pivot turns or complete reversals within the machine radius. Joy says the equipment can be tailored for virtually any head room or loading height requirements.

Joy claims that the shovel loader can load two to four tons per minute. The loader can muck in round or rectangular shafts and takes over loading in the tunnel when the shaft reaches bottom. Buckets ranging in size from 5 to 11½ cubic feet are available.

In tunnel construction, the JMD-7 dozer cleans up invert sections before concrete is placed. It is used for cleaning out old, silt-laden water and sewage tunnels.

The tractor serves not only as a base for the shovel loader and dozer, but for various other attachments as well. These make it a full-face drill jumbo, roof bolter, front end loader, back-hoe, scaler or fork lift; it can do general drawbar work. Drawbar pull is 12,080 pounds.

Differential Pressure Transmitter — Bothersome purge and seal problems have been eliminated with the announcement of the new Taylor volumetric differential pressure transmitter. This instrument has been found to be ideal for many difficult flow and liquid level applications, such as measurement of slurries, colloidal suspensions, fluids that jell when not in motion and many corrosive liquids. Corrosion-resistant diaphragms of stainless steel or nickel prevent process material from reaching the instrument, and thus the need for purges is eliminated. Two mountings are available for applications involving corrosive liquids or slurries. For corrosive liquids, if the diaphragm need not be flush mounted, a wafer-type sensing element is available. This element, mounted in a standard three inch ASA flange is particularly useful for liquid level measurement.

Rayonier Expansion — Rayonier Incorporated have announced that the chemical cellulose producers' major expansion and modernization program of its Port Alice, British Columbia mill is nearing completion, and that the company's new mill at Jesup, Georgia will be in commercial production by mid-November of this year.

Change of Address — Grant Bros. Sales Ltd. of Toronto, Canada, Canadian sales representatives for Cummins Power Tools, recently moved from 334 Lauder Avenue to 18 Hook Avenue, Toronto, Ontario.

Canadian Comstock Company Limited, engineering construction, Toronto, announced recently that Canadian Comstock had acquired a partnership interest in Consolidated International Electric Co. Inc., New York and Toronto. Consolidated International Electric is similarly an engineering construction firm operating throughout the world in areas outside Canada and the United States.

Canadian Westinghouse — The Canadian Westinghouse Company, Ltd., will step up its capital spending in the next two years to the rate of $5,000,000 annually, according to a report by George L. Wilcox, president of the company. Purpose of the increased capital investment will be to improve the company's earning power and productivity, and to enable it to keep up with the growth of its business and the progress of the electrical manufacturing industry in Canada. The company's capital expenditures in 1957 will total about $3,500,000, and in 1956 were about $1,200,000.

New Diesel Organization — The board of directors of the Propane Credit Corporation Ltd., Edmonton, have announced that they have acquired control of Western Diesel Energy Ltd., as a wholly owned subsidiary. Western Diesel Energy Ltd. will be the retail outlet for Deutz Diesel engines and equipment, and Propane Credit Corporation Ltd. has acquired the sole distributorship for Deutz Diesel in Alberta, Saskatchewan, Yukon and the North West Territories. A new building has been erected for the use of Western Diesel Energy Ltd. and Propane Credit Corporation Ltd., and is located at 9765-63rd Avenue, Edmonton.

Exploration Service — A completely integrated exploration service has been announced by Geophysical Prospecting Company Limited, London, and Canadian Aero Service Limited, Ottawa. The two companies have joined their technical skills and capabilities for air and ground surveys outside Canada, for the oil and mining industries and for governments interested in developing their natural resources. Their headquarters are located at 20 Albert Embankment, London, S.E.11. Geoprosco and Canadian Aero will perform airborne geophysical surveys by magnetometer, scintillation counter, and electromagnetic detector, as well as magnetic, electric, gravimetric and seismic surveys.

Price of Commercial Explosives — A reduction in the price of commercial explosives shipped in fibre boxes has been announced by Du Pont of Canada. The reduction, 25 cents per 100 pounds from regular prices, is effective on all shipments in fibre containers. The company said that fibre shipping boxes produced at Nipissing Works, its explosives plant near North Bay, Ont., afforded economies in manufacture and in line with its policy these economies were being reflected in its price structure. Prices on explosives packed in wooden boxes remain the same.

Polystyrene Foam — Dow Chemical of Canada, Limited, has announced the construction of a plant in Sarnia for the production of an entirely new product for the Canadian market. A polystyrene foam plant is now in the early construction stages and is expected to come on stream in the spring of 1958. The new product will be processed from polystyrene, expanded to produce a sparkling white non-interconnecting cellular structure. Product qualities include light weight, low thermal conductivity, inherent water resistance and high compressive strength. The new polystyrene foam plant brings to a total of fourteen the number of plants operated by Dow in the Chemical Valley.

New Office Location — Foundation of Canada Engineering Corporation Limited has announced a change of location of its Toronto office to 8 Spadina Road, Toronto 4, Ontario, telephone WA. 4-3737.

C.N.R. Contract — Canadian National Railways recently awarded a contract to Bridge & Tank Company of Canada Limited of Hamilton, Ont., for the manufacture and erection of the steel superstructure for the Victoria Bridge Railway diversion at Montreal. Victoria Bridge is one of the spans linking Montreal Island with the mainland. The contract is said to be one of the largest fabricated steel contracts to be awarded in Canada in recent years. The 13,000 tons of steel required in the Victoria Bridge construction will result in the maintenance of substantial employment in the Hamilton Bridge division of Bridge & Tank for the next three years and will benefit Canadian steel mills at this time of decreasing steel production. Work is expected to begin on the project early in the spring. The take-off point for the alternate structure on the upstream side will be two-thirds of the way across the bridge from the Montreal side. The project is in co-ordination with the St.

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Lawrence Seaway Authority lock at St. Lambert and is necessary to provide for the passage of trains with a minimum of interruption. Operation of the nearly mile-long diversion route is expected to be under way prior to the opening of seasonal navigation in the spring of 1961. Total costs of the work in connection with the structure, including the contract now being awarded, is estimated at $17 million.

Federal Public Works Contracts — Public Works Minister Howard Green has announced that contracts involving expenditures totalling $562,267.54 were awarded by the Federal Department of Public Works during the month of December, 1957. The amount for new works in building construction is $542,597.00 and for the repair and maintenance of existing structures is $6,250.00. The amount for the repair and maintenance of existing structures in harbours and rivers is $13,420.54.

Contracts involving expenditures totalling $3,314,060.43 were awarded by the Federal Department of Public Works during the month of January, 1958. The amount for new works in building construction and harbours and rivers engineering is $2,676,890.16; for the repair and maintenance of existing structures $137,170.27; and for the extension of the Mackenzie Highway $500,000.00.

Cellulose Sponge Manufacture Discontinued — Plans to discontinue manufacture of cellulose sponge, produced at its Shawinigan Falls, Que., plant were announced recently by Du Pont of Canada. The company said the Canadian-made product could not compete with the increasing flow of imports entering this country. The company instead will supply the Canadian market through the resale of sponge imported from the United States.

Winter Unemployment — The efforts of one company to relieve winter unemployment problems were described recently to the Electric Club of Ottawa. J. S. Keenan, vice president and general manager of Canadian General Electric Company's industrial products department, said his department was scheduling its capital expenditures so that much of the work involved could be done during the winter months. Other projects, such as renovation of buildings and relocation of equipment, were also being pushed forward during the winter. Mr. Keenan said his department is manufacturing special export orders this winter which were taken some months ago on a no-profit basis. These export orders have reduced the layoffs caused by the temporarily smaller home market for some electrical products. He indicated his department was pursuing a vigorous 'Buy Made in Canada' program in the purchase of machinery and materials to help Canadian suppliers of these items provide more jobs in their factories.

Union Carbide's New Division — Union Carbide Canada Limited has taken over the assets and undertakings of Visking Limited, Lindsay, Ontario. Visking's business will now be carried on under the name Visking Company, division of Union Carbide Canada Limited, and will join the other five divisions of Union Carbide Canada Limited which are Bakelite Company, Carbide Chemicals Company, Electro Metallurgical Company, Linde Air Products Company and National Carbon Company. Mr. L. A. Hanson, formerly vice-president of Visking Limited, becomes president of Visking Company, division of Union Carbide Canada Limited. Visking makes a wide variety of food casings used by packers for processed meat and sausage products, as well as polyethylene film and tubing. The main plant and offices are in Lindsay, Ontario and a second plant is being built and is nearing completion in Winnipeg.

Price Change of Domestic Nickel — To compensate for recent changes in foreign exchange rates, and to keep the domestic price of nickel in accord with the basic export price, The International Nickel Company of Canada, Limited recently announced a change of 2½ cents per pound in its price of electrolytically refined nickel, for consumption in Canada, increasing the price from 69 cents

(Canadian currency) to 71½ cents per pound from its Port Colborne, Ontario, refinery. The price change does not alter the company's price of nickel for the United States or any other markets.

Vidamp Distributors — The appointment of distributors to handle the sale of Vidamp machine mountings has been announced by the manufacturer, textile division, of Dominion Rubber Company Limited. Vidamp will be generally available through branches of The Canadian Fairbanks-Morse Company Limited and Rudel Machinery Company Limited, while sales to the textile industry will be handled by W. J. Westaway Company Limited. These appointments have been made to provide industry with more rapid service and assistance in the use of Vidamp, a Canadian made felt product especially designed as an anti-vibration mounting for machinery of all types. Vidamp is said to have found wide use in machine shops, textile mills and printing plants, where it also allows the installation of machinery without lag bolts or braces, and provides more satisfactory working conditions for employees.

Publications

A new quarterly customer publication "Atlas Copco Compressed Air Comments" has been announced by Atlas Copco Canada Ltd., the Canadian affiliate of the world-wide Atlas Copco Group, manufacturers of compressed air equipment. The two-colour publication will carry news and information about the various applications of compressed air in industry.

The first issue carries two special stories — "The Use of Compressed Air for Winter Ice Removal" and "Growth in World Markets for Tungsten Carbide Drill Steels."

Maintenance of Air Tools—A 28-page booklet, "Working on Air", released recently, is a humorous guide to the maintenance of air tools, using cartoon technique by the Canadian artist, "Ricky". Atlas Copco Canada Ltd.

Radiographic Materials — Kodak industrial radiographic materials are illustrated and described in a new Kodak pamphlet, "Materials and Accessories for Industrial Radiography", which contains a guide chart for selection of Kodak film for various material thicknesses.

Lumber Packaging and Loading—A new "Handbook of Instructions for Packaging and Loading Lumber for Shipment in Box Cars" (AD 243 1-58) is a 28-page manual containing over 50 illustrations and diagrams. Acme Steel Company.

Architectural Aluminum — Three new brochures describe finishes, care during construction, and care in service for Alcan architectural aluminum. Appendix of proprietary products available also. Aluminum Company of Canada, Limited.

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Ductile Iron — An illustrated 8-page booklet has been published describing a new cast material combining the founding characteristics of cast iron with toughness and strength levels usually associated with carbon steel. The booklet contains 24 case records. The International Nickel Company of Canada, Limited.

Photogrammetry — Canadian Aero Service Limited have available a new brochure which reports on the application of aerial surveys to engineering problems.

"Timing" Belt Drive — Catalogue TB-58 recently announced by Morse Chain Company is said to mark the first time information on all five basic "Timing" Belt pitches has been available in a single catalogue, and is available on request to the company.

Insulation — Brochure R.A.I.C. File No. 37-C has been designed basically as a reference book for the architect and the engineer when including J-M Spintex insulation in specifications for mineral wool home insulation. Canadian Johns-Manville.

Ancient Use of Nickel — Early history of nickel has been rolled back some 4,000 years as the result of research findings presented in a paper published in the October 1957 issue (Vol 61, No. 4) of the *American Journal of Archaeology*. The International Nickel Company of Canada, Limited.

Pipe Laying — Canada Iron Foundries, Limited have made available a booklet describing the Tyton Joint, a new, tight joint for cast iron pipe.

Utility Sets — A new 28-page illustrated 2-colour catalogue describing the new line of HS Utility sets is now available from American-Standard Products (Canada) Limited—Canadian Sirocco Products (Bulletin 8414).

Machine Control — Recently made available by the electronics division of Canadian Westinghouse Company—a 12-page booklet on the Westinghouse "Nultrax" electronic machine tool control unit; there is a section on application to machine tools, precision instruments, and assembly operations.

Drop Forged Turnbuckles — This 4-page brochure gives details of Stelco drop forged turnbuckles and hot galvanised turnbuckle assemblies. The Steel Company of Canada, Limited.

Models in Plant Design — Published recently by The M. W. Kellogg Company, "Models: New Route to Better Plant Design" discusses scale models as a tool to communicate engineering concepts and to improve methods of designing process plants (Kelloggram, 1957 series, issue No. 5.).

United Kingdom Trade — A booklet describing their services has been made available by Transatlantic Engineering, a firm of British consultants. The booklet may be of assistance to any Canadian firms interested in dealing with the United Kingdom.

"The Testing World" — Soiltest Incorporated would be glad to send regularly a copy of their publication "The Testing World" to anyone interested in receiving it.

Notes from Britain

New Boilers For Oil Refinery — Two new package boiler units each weighing 36 tons were supplied recently by Mitchell Engineering Ltd., Bedford Square, London, W.C.1, England, to the Shell Petroleum Company, Ltd., oil refinery at Lutong in North Borneo. The boilers, which are of the water tube type, can generate 33,100 pounds (15,013.9 kilograms) of steam per hour and are fired by oil or gas.

Dust Collection—A new range of dust control equipment for industry is being introduced by Dallow Lambert and Company, Ltd., of Thurmaston, Leicestershire, England. The firm claims that it is particularly suitable for engineering works where there is machining, grinding and polishing of metals, for foundries and for coal and coke handling plants. Dust collected by the equipment is drawn into a main collecting chamber where it is mixed with water to form a sludge. The advantages offered by the equipment are said to be a high collection efficiency and absence of fire risk, less space and no secondary disposal problems when dust is removed.

Glass Fabric Strengthens Bitumen — A new fabric named "Tygascrim" is now in production by Fothergill and Harvey, Ltd., of Manchester, England. Although light in weight—only 2.2 ozs. (57 grams) per square yard (0.84 square metre)—this fabric has considerable tensile and bursting strengths. The coating ensures compatability with most compounds used in water-proofing. The fabric will withstand temperatures up to 1,000 degrees Fahrenheit, and prevents compounds to which it is applied drying out by conduction of vaporisable oils to the surface, a process which the glass filaments of the fabric inhibit. It is stated that "Tygascrim" is suitable for all roofing and water-proofing applications, and that it can be successfully used for the spiral wrapping of underground pipes and the lining of interiors of oil storage tanks.

Plastic Bonded To Steel — What is claimed to be one of the most remarkable materials ever produced by the steel industry, "Stelvetite", is now being made by John Summers and Sons Ltd., Shotton, Chester, England, in co-operation with BX Plastics Ltd., of London. It consists of a sheet of steel permanently covered on one side with a sheet of specially formulated Velbex P.V.C. (polyvinylchloride) made by BX Plastics Ltd. The plastic is a thick coating, not a film, available in a very wide variety of finishes and colours. Described by the manufacturers as the "steel with the built in finish" it is claimed that it will revolutionize many industries.

Electronic Milk Testing—A portable device which is simple to operate has been developed by an English firm for use in the examination of milk by farmers. An electronic device, it has been designed to aid farmers to detect the occurrence of mastitis infection in milk during the early stages of the disease. The testing of milk takes only a few seconds to perform and the Mastitis Meter, as it is called, gives a direct reading showing the condition of the milk on a dial. The device registers the electrical conductivity of the milk. The conductivity measurement changes when mastitis infection occurs due to the presence of increased quantities of chloride in the milk. The development is important as it may enable farmers to spot the onset of mastitis infection in a herd at a very early stage and thereby enable the sick animal or animals to be isolated and treated before the disease can spread. Firm: W. G. Pye, Ltd., Granta Works, Newmarket Road, Cambridge, England.

● MONTH TO MONTH *(Continued from Page 114)*

DOODLES AT COUNCIL →

This work of art was discovered on the table after a meeting of council at Seven Islands. There is in it a clear tip-off as to the identity of the artist—if you're interested.

BRANCH ACTIVITIES REVIEW

Above: President C. M. Anson (seated) visited the city hall at Sherbrooke, Que., in November. In his party were: G. Cote, R. L. Dunsmore, Gaetan Cote, L. Austin Wright, R. D. Mawhood, Branch chairman, G. M. Dick, Jacques Lemieux, and Gaston Masse.

←

Visiting Shawinigan Falls in November, President Anson met this large group of members at a dinner meeting.

B. M. Monaghan (right) of Seven Islands Branch, offers greetings to V. M. Wallingford, chairman of the new Baie Comeau Branch.

Inauguration of the Baie Comeau Branch in December was the occasion of this gathering. In the foreground: Mrs. G. Scott, Mrs. N. Lapierre, Mr. Anson, Mrs. Wallingford, Mrs. Suttie, Mrs. Monaghan and M. Pope; second row: G. Scott, P. Suttie, Mrs. Anson, N. Lapierre, Mrs. Pope, V. M. Wallingford and B. M. Monaghan.

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MEMBERSHIP

ABC CCAB BNA

Indexed in The Engineering Index

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Ottawa,
April 4, 1958.

Mr. C.M. Anson, M.E.I.C.,
President,
The Engineering Institute of Canada,
Montreal 2, Que.

Dear Mr. Anson:

To the Engineering Institute of Canada I extend my heartiest congratulations on the completion, this month, of forty years of continuous production of THE ENGINEERING JOURNAL.

The Institute had completed thirty years of service to Canada and the profession of engineering when, in 1918, it commenced publication of its Journal "to facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public". Ever since its inception this outstanding all-Canadian technical publication has fulfilled its purpose.

Today Canada is experiencing one of the greatest periods of industrial expansion known to mankind. It is my earnest hope that THE ENGINEERING JOURNAL may continue to be of increasing service to Canada, through her engineers who are playing such leading parts in so many aspects of our beloved country's development.

Yours sincerely,

John Diefenbaker

CANADA IN 1957

THE CANADIAN economy slowed down in 1957 from its upward surge of the past few years. A softening in world commodity markets affected most of the agricultural, forest, and mineral products important in Canada's export trade. Industrial production slid gently downward throughout the year from its February peaks. The gross national product at some $31 billion exceeded the 1956 volume of $29.55 billion by about 4 per cent, but after taking price increases into account, total production of goods and services showed little change from 1956 and on a *per capita* basis were somewhat lower.

The rate of capital expansion for the past few years, though maintained, was at a slower rate, and volume of new work coming forward declined. Though activity in the principal service lines continued to expand, mining and manufacturing output had declined since early in the year. Whereas demand for forest products had weakened, increased output was seen in chemicals, electrical and industrial machinery, primary iron and steel, and railway transportation items. Sales of autos and trucks were somewhat below 1956. Fewer housing completions softened the market for appliances.

Total employment increased about 2½ per cent. Total labour income, though levelling off in the 4th quarter, had risen by 9 per cent in the first three quarters. Personal incomes, in aggregate, continued upward. Real purchasing power rose by about 3 per cent. Consumer credit showed little further increase.

World trade did not expand as rapidly in 1957 as in the two preceding years. Canadian merchandise exports changed very little from 1956. Base metals and lumber were in much easier supply, though exports of uranium increased threefold. Oil exports increased about 40 per cent but demand fell off considerably in the last two quarters. The upward trend in iron ore shipments had flattened out. Though imports remained steady for the first three quarters they declined in the fourth quarter.

Bank executives point out that levelling out of Canada's boom has its advantages; continuation of the 1956 rate of expansion would have subjected the economy to severe stresses and strains. A slackening was desirable so it might consolidate its recent gains and resume its advance from a more solid foundation.

Trade Minister Gordon Churchill, in a year-end message, described the present economic situation as a "pause in expansion". Though there was little likelihood of significant strengthening in world commodity markets, there was strong underlying supports for the economy, he pointed out. Consumer demand would be an important sustaining influence.

Employment Drop Sharpest in Resources Industries

At year-end, unemployment was becoming serious. Industries which had been showing the greatest drop in employment were forestry—down more than a third from 1956; agriculture—down less than 3 per cent; and construction and transportation —each down about 1 per cent. Utilities and service industries remained buoyant, continuing the pronounced trend of recent years. The current slackness was thus most pronounced in resource and export industries, especially forest products and minerals, whose pick-up must depend on events in the United States and overseas.

But output per man was increasing. Since October, employment had been falling more rapidly than production. It was catching up with the decline in production which had started almost a year before. Falling employment thus represented, in part, a shakeout which had to come.

Employment Covered in Review

Employment at some 2,230,000 in the mining, petroleum, transportation, construction and heavy manufacturing industries that are covered in the following review, represents the production effort of some 43/45 per cent of Canada's civilian non-farm labour force, which averaged 4,608,000 for the year, or the effort of some 48 per cent of all paid workers. The remaining proportion are employed in such industries as clothing, textiles, food, beverage, retail trade, printing and publishing, tobacco, rubber and leather footwear, and all service industries.

In the pages that follow, the coverage for each industry is confined to records of production supplied by the Dominion Bureau of Statistics, from financial reports and press statements, and from Government information releases. In addition, comments and forecasts of industry leaders are quoted. In view of the uncertainty in predicting future trends, no general forecasts are made about the outlook for 1958.

40 YEARS OF PUBLICATION 1918 - 1958

This issue of *The Engineering Journal* marks the completion of forty years of uninterrupted publication — a period that includes two world wars and the depression years of the thirties. The progress of the *Journal* is reviewed on pages 135 and 232.

Symbolizing the work of the miners who play such a large part in the development of Canada's mineral resources, the picture at right shows cars removing rock and gravel from the second 2 1/2-mile tunnel under Mission Mountain, B.C. Many hardrock miners are engaged in the work, although the primary purpose is the development of the Bridge River for hydro-electric power. In addition to mineral ores, oil and gas are major natural resources; the lower picture shows a typical oil-drilling rig in south-western Manitoba.

METALLIC ORES

NON - METALLICS

PETROLEUM

NATURAL GAS

MINERAL RESOURCES

CANADA's MINERAL production set another all-time record for value in 1957, in spite of lower prices and lessening demand combining to shrink markets and cut production of many minerals, thus reducing earnings of many companies to well below 1956, the nation's mining industry on the whole enjoyed another big and profitable year. With inclusion of petroleum and natural gas, both of which showed moderate increases, total production value of $2,085 million in 1956 was topped by 2.5 per cent, at $2,134 million.

The year 1958 will be a difficult one in some respects, with further reductions expected in many items unless the overall business picture improves materially. Yet the promised threefold expansion next year in uranium output could turn the tide and result in another all-time record for the industry as a whole for 1958.

Base Metals, Gold, and Coal Output Off

Many minerals in 1957 showed a smaller volume of output and many had their production curtailed by reduced prices. Outstanding in this category were copper, lead, and zinc, usually the industry's star performers. Worldwide expansion of production of these metals had raised their production to high levels, while demand from the consuming industries, as well as government demands for stockpiling, had fallen off. Today with more supplies available than demands can absorb, production cutbacks are widespread.

Metals declined in value to $1,136 million from $1,146 million in 1956. Prices of copper, lead and zinc fell. Gold production for 1957 was about the same as 1956, but its value was reduced by about $2 million due to the premium on Canada's dollar cutting the price.

Other metals show a combined reduction of production amounting to some $5 million, while non-metallics production value showed a gain of some $7 million.

The value of coal production suffered another $5 million drop, due to the further inroads of competition from other fuels and to the lessening demands from industry generally. Fuels other than coal showed a gain of $42 million, and structural materials gained $15 million.

Uranium, Asbestos, and Nickel Better

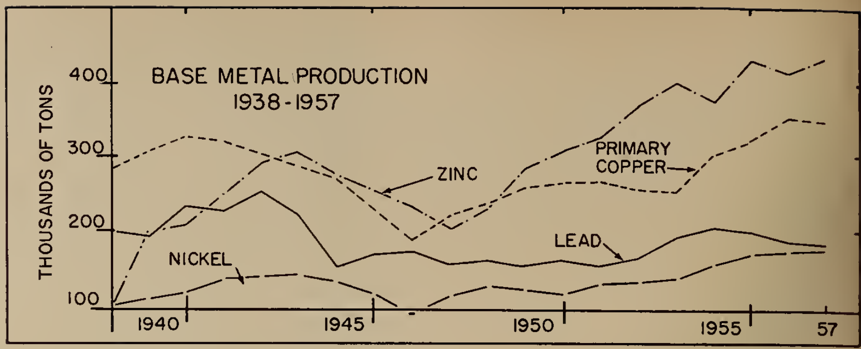
Canada is established as one of the world's top uranium producers and has the advantage of fixed-price sales contracts with the government. Since few of the contract mines are yet in full production, Canadian output will increase sharply during the next two years. Output has jumped to some 12.9 million pounds, worth $131 million in 1957 from $46 million the previous year, and by mid-1958 will be established at a rate exceeding $300 million yearly.

Iron ore continued to grow in importance and 1957 output was close to 1956 tonnage despite slackening steel activity in the United States where most of it is marketed. Prices were up 5 to 6 per cent. Production in 1957 will reach a total of slightly in excess of 22 million tons with a value of $156 million. A few years ahead it will exceed 40 million tons annually valued at about $400 million.

The outlook for nickel is also encouraging. In spite of abatement of U.S. stockpile requirements, unlimited supplies will now be available for civilian industry for the first time since 1939. Nickel producers will be now able to make unrestricated sales efforts and increased usages and sales can be expected.

Industry Affairs

A delegation of Canadian Cabinet ministers conferred in Washington last fall with their counterparts in the American Administration on trade relations, and voiced the alarm and



dismay felt by the mining industry at the prospect of increased U.S. import duties on lead, zinc, and copper. The industry will have an opportunity of voicing its views to the U.S. Tariff Commission when that body reviews the lead and zinc situation.

The Diefenbaker government announced its intention to revise the Industrial Relations and Dispute Investigations Act (Federal Labour Code), a matter of great importance to the mining industry. All uranium producers with one exception now operate under the code.

During the month-long tour across Canada last September the sixth Commonwealth Mining and Metallurgical Congress visited all the important Canadian mining camps and metallurgical centres from Kitimat and Trail in the west through Edmonton, Beaverlodge, Steep Rock, Blind River, Sudbury, Timmins and Noranda to Schefferville in Ungava and Sydney, Nova Scotia. They also toured the St. Lawrence Seaway. The party included some 350 visitors from 36 countries. The tour was sponsored by the Canadian Institute of Mining and Metallurgy.

View from inside concentrator at Steep Rock Iron Mines, Ontario. Feed end of scrubber, left foreground, spiral section, lower centre, and heavy media drum.

METALLICS

Iron Ore

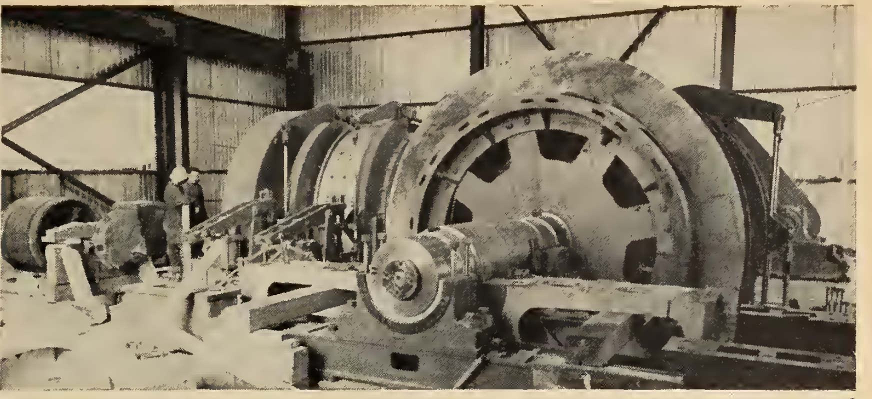
Steel producers who have been worried over an ore famine since World War II now find there is a plentiful supply, yet both prices and consumption are holding close to peak levels. Canada has climbed to fourth place behind the U.S., Russia, and France; ahead of Sweden, the U.K., and West Germany. Final figures for 1957 showed its 10 producers had turned out 22 million long tons worth $156 million, with 1958 production pointing definitely higher.

As a result of the new trend to beneficiation and increased use of high-grade pellets of 64% iron as an ideal blast-furnace feed, most big U.S. ore consumers are looking to Canada for lean Canadian ores that can give a richer pellet than U.S. taconites and jaspers.

The bulk of Canada's iron ore is exported: 13.7 million tons of the nation's 1956 production total (22.3 million tons) went across the border, 2.5 million tons went to Britain, while shipments to West Germany, the Netherlands, and Japan followed in that order. Canada imported 4.52 million tons in 1956, most of it going to Hamilton steel mills. In 1957 essentially the same export import pattern was followed, but with a quickening interest by West German and other European nations for high grade concentrates.

More than half Canada's production comes from the Ungava Knob Lake fields. Marketing some 12.6 million tons in 1957, Iron Ore Co. of Canada should expand output to 20 million tons in the next few years. Two new producers are assured for 1958: Hilton Mines in the Ottawa Valley is readying a $16 million concentration plant, while Lowphos Ore Ltd. will ship concentrates from its plant near Capreol, Ont. Caland Ore Co. is continuing its huge dredging operation but will not be in production before 1959.

Canadian Charlson, near Steep Rock, plans a concentration plant for a 250,000-ton production in 1959. Leading the search for low grade deposits that can be agglomerated and which promise tomorrow's big developments is U.S. Steel's Quebec Cartier Mining Co., 300 miles north of Shelter Bay on the St. Lawrence. With expenditures already reaching $10 million, it could go as high as $300 million by time production starts in 1961. It may turn out to be a 10-million ton yearly operation. Other big interests in the exploration stage include Canadian Javelin, Quebec Cobalt, and Albanel Minerals.



Hoist room floor at Steep Rock development. Two 132-in. skip hoists on parallel mounts, right, and 100-in. cage hoist, at left rear.

Uranium

Canada continues to rank third in uranium production after the United States and South Africa, though it will probably assume leadership during late 1958 or early 1959. In 1957 Canada produced 12.9 million pounds of uranium oxide, valued at $131 million, almost a threefold increase over 1956. Canadian reserves are estimated at 225 million tons, containing some 237,000 tons of uranium oxide, compared with some 175,000 tons of oxide in the U.S., and 370,000 tons of oxide in South Africa.

There was little incentive for prospecting for new deposits during 1957. Deadlines for qualification for premium price contracts are passed and, with no promise of five-year amortization, only exceptionally rich further deposits could be mined economically at present. Premium price contracts have been designed to repay capital within a five-year period, which made it easier to raise the huge sums of money needed.

The need for cheap energy has forced Europe and to a lesser extent America to make use of oil, gas, and coal as primary fuels for producing electrical energy. Britain with less plentiful supplies has taken the lead in developing uranium-burning power plants. With demand increasing it is natural to consider possible successors to uranium but, so far, none exist.

Canadian contracts for uranium awarded to companies now producing or with plants under construction total over $1.5 billion. These contracts expire in 1963. Prices average around $10 per pound of contained uranium oxide. Eldorado has options on further production at prices equivalent to the U.S. price of $8 per pound until 1966. The standard price in Canada for other than contracts calling for premium prices remains unchanged at $6.00. Eventual maximum rate of output from companies now in production alone is estimated at close to $400 million annually.

Producers

In the Beaverlodge camp, Eldorado Mines' new plant commenced production in 1957 at 500 tons daily, to be raised to 750 tons in 1958. It takes ore from Cinch Lake, National Explorations, and Cayzor Athabaska Mines. Eldorado moved treatment rate at its Uranium City plant up to 2000 tons daily and handles 150 tons daily from Rix Athabaska on a three year contract. Rayrock started a 150-ton mill at Marian River in June. The Eldorado Plant at Port Radium continued at normal production of 200 tons a day.

In the Bancroft area of Ontario, Bicroft smoothed out operations at its 1000-ton plant, while Faraday started its new plant up in April. This mill also handles shipments from Greyhawk. Canadian Dyno continued construction and will produce 1000 tons daily early in 1958.

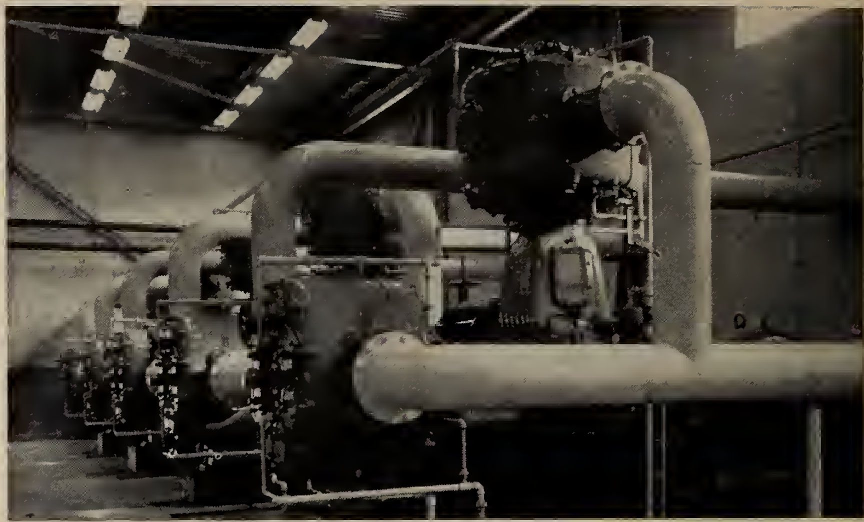
At its Blind River plant in Western Ontario, Pronto Uranium stepped up tonnage to 1500 tons daily and is proceeding with deeper development.

Milliken Lake Uranium Mines property in early winter. In foreground: mine dry and office building, grinding and crushing bay, service and production headframes. Enclosed concentrator in the background.

Algom brought its first 3000-ton mill into operation in 1956 at Quirke and the second one of the same size at Nordic was operating at capacity early in 1957.

Precipitate shipments from Consolidated Denison started in June 1957 and the mill is gradually being brought up to 4000 tons daily with a target of 6000 tons daily early this year. Northspan's Nordic Lake Mill of 4000-ton capacity started production at 2000 tons in September. Its Panel Lake Mill will open late in 1958 and its 2000-ton operation at Spanish is close to production.

Can-Met Explorations' 3000-ton mill will be operating below capacity until underground work is opened up further. Stanleigh started feeding its 3000-ton mill late in 1957, while Stanrock expects to have its 3300-ton mill ready for production in February 1958. Milliken Lake Uranium will commence production at its 3000-ton mill in the spring.



Dry vacuum systems using piston type pumps in the Algoma Blind River mining area. Design factor is 1 c.f.m. piston displacement per sq. ft. filter surface.

Nickel

With a slowdown in the industrial boom, slackening in defence orders, and large scale diversions of U.S. stockpile quotas, the grey market for premium priced nickel is tapering off and producers face a struggle to regain markets lost to substitutes. Diversion of stockpile quotas, however, merely means producers may attempt to dispose of nickel contracted for by the U.S. Government to private industry. If unable to get the price they would receive from the Government the producers can require the Government to buy it at the contract price.

Canada, world's largest producer of nickel, produced close to 376 million pounds, worth $261.2 million in 1957, compared with 357 million pounds the previous year. This is 75.3 per cent of estimated 1957 world production of some 490 million pounds. Anticipated world production is estimated at 650 million pounds by 1961. Availability of this greatly increased supply may create serious marketing problems for producers, especially if defence consumption should be further curtailed, requiring a 75 per cent increase in peacetime industrial uses of nickel by 1960.

Open pit and smelter of Hudson Bay Mining and Smelting Co. Limited, Flin Flon, Man.

International Nickel, world's largest producer, sees the most promising field for expansion in stainless steel, turbines, machine tools, corrosion resistant uses, and for chemical plants, electronics, nuclear power, missiles, and space ships, as well as in the hundreds of conventional peacetime uses. A vast increase in Inco's production will come from the new properties in Manitoba, now under development. These are being readied for production by 1960.

Arcadia Nickel will commence production early in 1958. Another possible addition is the Gordon Lake division of Eastern Mining and Smelting near Kenora. E.M. & S. is also planning another smelter and refinery at Chicoutimi, Quebec. This smelter will treat ores from Nickel Rim, Gordon Lake, Arcadia, North Rankin, and Canalask, as well as ores from custom smelting from other parts of the world. During the year 1957 North Rankin Nickel mines brought its 250-ton per day mill into operation.

Copper

Overproduction and sharply reduced prices spread gloom over the copper mining industry throughout 1957. The all-time highs in tonnage production and value in 1956 of 353,293 tons valued at $293 million were cut sharply. Production of new primary copper in 1957 averaged some 28,000 tons monthly, off some 1,700 tons from the pace set in 1956. Production for 1957 was valued at $199.5 million, a drop of almost one-third.

What this means to Canadian copper mines is shown in Canada's export trade figures. Annually we export some 70 per cent of our output. In the first 8 months of 1957 we exported 37,500 tons more than in the previous year, yet we received $4.9 million less for it.

World production has not only caught up with demand, but has passed it by a substantial margin. Fabricators took only slightly less than the previous year's tonnage, but weakness in prices (down to 25¾ cents in October from the all-time high of 46 cents in July '56) was the severest on record. To remedy the situation, producers must develop increased consumption or cut back production, neither of which is easy.

Some New Mines - - Some Failures

While the search for new mines slowed down during 1957, Maritimes Mining opened an 1800 ton mill in Newfoundland in September, while Buchans Mining Co. continued shaft-deepening operations. Heath Steele Mines began tune-up of their 1500 ton concentrator in New Brunswick. Merrill Island will start up its 650-ton plant in January; Copper Rand, Bouzan, Quebec Chibougamau, and Bateman Bay are in various stages of exploration and development. Chibougamau-Jaculet has suspended operations due to lack of ore. Beattie-Duquesne, Lyndhurst, and Duvan have suspended operations.

The five month strike at Gaspé Copper Mines held off a large slice of production. Geco Mines and Wilroy Mines commenced production in Ontario. Coldstream was treating 600 tons daily. Hudson Bay Mining profits were down for 1957 though Sherritt Gordon has done better. In B.C., Woodgreen copper is in bankruptcy, Midwest and Granby have ceased work, and Britannia is considering closing down.

Two of the Rio Tinto group operations are Northspan Panel Uranium Mines, top, and Northspan Spanish American, at Quirke Lake, Ontario. The Panel mine has the two mine shafts on islands in the lake; No. 1 shaft is reached by a causeway.

Lead

The available supply of lead has been running in excess of consumption. Decreased industrial activity, levelling off of U.S. stock-piling and barter programs and intended British stockpile sales, have upset the delicate pattern of supply and demand. Canadian production for 1957, valued at $52.4 million, was 10% below the same period of 1956. Refined output has been running close to 1956 figures when total output was 147,865 tons. Canadian exports have shown some increases over the previous year.

During 1957, due to softer markets and suspension of U.S. barter deals, four price-cuts reduced the price from 16¼ cents in May to 12¾ cents in October. The U.S. Tarriff Commission may raise the lead import duty by 2.55 cents per pound from the current 1.0625 cents. Lead imports were slashed considerably in 1957 following the opening late in 1956 of the Ethyl Corporation of Canada plant at Sarnia. Lead consumption in Canada should show an uptrend for the full year 1957 due to the opening of this plant.

Principal source of lead and zinc in Canada is the Sullivan Mine of Consolidated Smelters at Kimberley, B.C. The Company operates the only lead refinery in Canada and treats domestic and foreign ores and concentrates. It also operates the H. B. and the Bluebell producing mines.

Production at Tulsequah and the open-pit mine at Sullivan, Jardun mines at 'the Soo', and the Mayo mine in the Yukon, all suspended operations during the year. Consolidated Sudbury Basin Mines has deferred plans to open. Heath Steele Mines in New Brunswick is producing lead from its 1500 ton mill.

Zinc

The year 1957 was discouraging for most zinc producers and the immediate outlook for the future is cloudy. Output in 1957 was valued at $99.7 million, 20 per cent below that of the previous year. Price declines due to oversupply forced production curtailment or suspension. The U.S. stockpile of zinc is bulging and is unlikely to be added to. The U.S. barter system initiated in 1956 to trade farm surpluses for foreign metal supplies has met with disfavour. Slab zinc consumption is down for 1957 in the U.S., world's largest consumer.

Zinc producers in the U.S. are urging tariff increases. Hearings were scheduled for year end, with strong probability for a hike in duties. This would be a severe blow to all zinc-producing countries. Four drops in prices between May and August totalling 3½ cents brought Canadian price for prime western zinc to 10 cents.

In spite of all these ills, it was

predicted early last year that world production would create a new record. Today the estimate seems optimistic. Many U.S. and Canadian mines have shut down or curtailed production during 1957. For the first three quarters of 1957 U.S. zinc output was running 3½% over the previous year, though Canadian output for the same period was some 2% lower than in 1956.

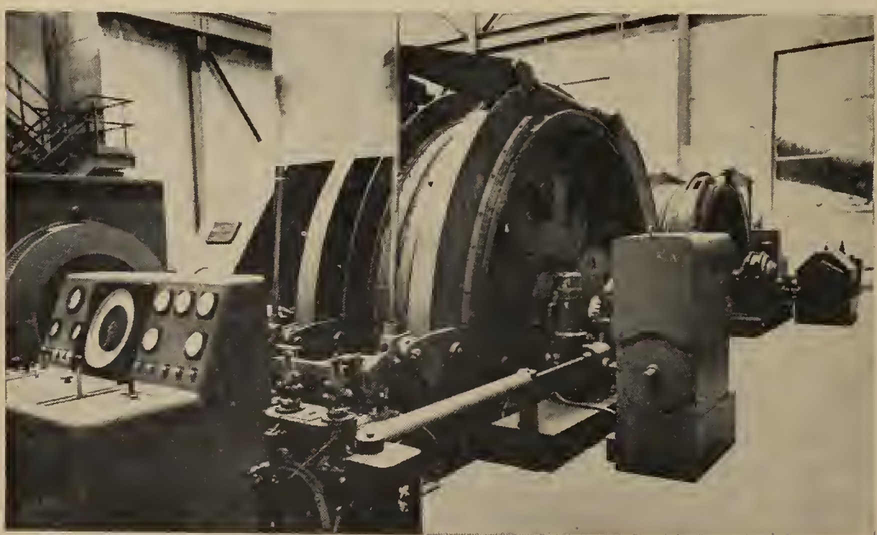
Besides the Consolidated Smelters' Kimberley Mine in B.C., where zinc is refined, Hudson Bay Mining and Smelting at Flin Flon produces and refines slab zinc. In 1957 the Company began shaft sinking at a new property at Snow Lake, Manitoba with an indicated deposit of nearly four million tons. Elsewhere, Heath Steele mines in New Brunswick commenced production in 1957 while Buchans in Newfoundland continued production and Brunswick Mining will soon be in production. Barvue and New Calumet mines in Quebec curtailed their production. Geco and Wilroy, in Manitoba, began production in 1957 with capacities of 3300 and 1000 tons daily, respectively. Surveys were under way for a rail route to the south shore of Great Slave Lake in the N.W.T. where large deposits are located.

Gold

Gold mines of the world have been passing through another difficult year. Free world production will again show a small increase of some $10/20 million: this will reflect merely the remarkable expansion in output from South Africa. Canada, in second position, will produce about 60,000 ounces less than in 1956, for a decrease of some $2.0 million in value.

From the mine standpoint there were few developments of importance during the past year. One new gold mine had made its appearance: French Mines, in B.C., with a 30/50-ton milling plant having started production. Howe Sound, in Manitoba, is on a salvage basis. Some old-established producers have raised their capacity slightly. Only one prospect, Taurcanis in the N.W.T., was doing underground development.

The 220-ft. concrete headframe at Geco Mines Limited, Manitouwadge, Ont., above. The friction type mine hoist, below, was designed and built in Canada.



Cobalt

Cobalt is passing through a transition period from the stimulus of government stockpiling to the growing pains of a civilian market. Canadian production will be close to the 1956 total of 1,843 tons, though domestic consumption will be sharply lower than the previous year's 218 tons, or nearer 63 tons. Exports are expected to total as much as 1,250 tons. Relatively little cobalt is imported into Canada. Price for cobalt in concentrate form, now pegged at $2.00, is only about half the rate of a year ago.

Canadian nickel producers are the principal sources of cobalt. Some 35% to 40% of all production is in the alloy field for high temperature alloys, jet engines, and atomic equipment, and offers best chances for the future. The permanent magnet industry uses 30% of all production, but is threatened by new materials.

Platinum

Reversing the position in 1956, when demand for platinum greatly exceeded the supply, the platinum metals are now in oversupply. Falling prices have cut values to $84/87 an ounce. The oil industry, largest consumer, has cut back its buying. Its use was a catalyst for making high-octane gasoline.

The United States is the main consumer of platinoids, last year at 975,000 oz.; Canada exported 287,544 oz. to the U.S. in 1956. A new use for platinum has recently appeared in the U.S.—an automatic electrical system using platinum disc anodes has been developed to protect ships' hulls and propellers against corrosion.

Canada's production for 1957 is not likely to be in short supply. Most of it comes from nickel producers. International Nickel's Manitoba development, and Eastern Mining and Smelting Co., at Kenora, are the largest untapped sources of the metal. Canada's domestic consumption in 1956 was valued at some $6 million and by 1958 it will rise with the increase in oil production. Canada's exports were down about $7 million below 1956 for the first seven months of 1957.

Silver

Canadian silver production in 1957 was at a rate only slightly higher than that of 1956, at about 30,100 ounces. Exports of silver in all forms based on production for the first three quarters had fallen about 10% below that of 1956. The market has been stable and indications are that it will continue so.

The three North American countries, Mexico, United States, and Canada, in that order, account for over half the world's production. Silver coinage takes much of the metal; Canada has been using greater amounts for coinage the past few years. The U.S. Treasury, Mexico, Saudi Arabia, West Germany, and Canada are largest users for this purpose. Most of it comes from producers of zinc, lead and copper.

Diamond drilling at the International Nickel Co. of Canada Ltd. site at Moak Lake.

Titanium

Titanium, the 'wonder-metal', has failed to live up to the publicity lavished upon it. Now the United States has indicated defence requirements for the metal will be substantially cut back. If it is to maintain its steady record of growth new markets must be developed for commercial use, and price reductions must be achieved in mill products. Today only half of the U.S. capacity production of 31,500 tons is in operation.

Ninety per cent of the titanium produced has been for jet aircraft and missile components, where its high strength-to-weight ratio and resistance to corrosion and fatigue gave it advantages. But the metal is meeting sharp competition from nickel alloys which, though heavier, can withstand more heat.

Potential civilian markets are in civilian aircraft, automobiles, anodizing and plating, papermill and chemical process equipment, and marine fittings, while 95% of world output of titanium-bearing minerals is used in the titanium pigment industry, a market of first importance to Canada, which is the world's leading producer of titanium slag and has the largest known deposits of ilmenite. World production of ilmenite and rutile concentrates doubled in five years to 1,789,400 tons in 1956.

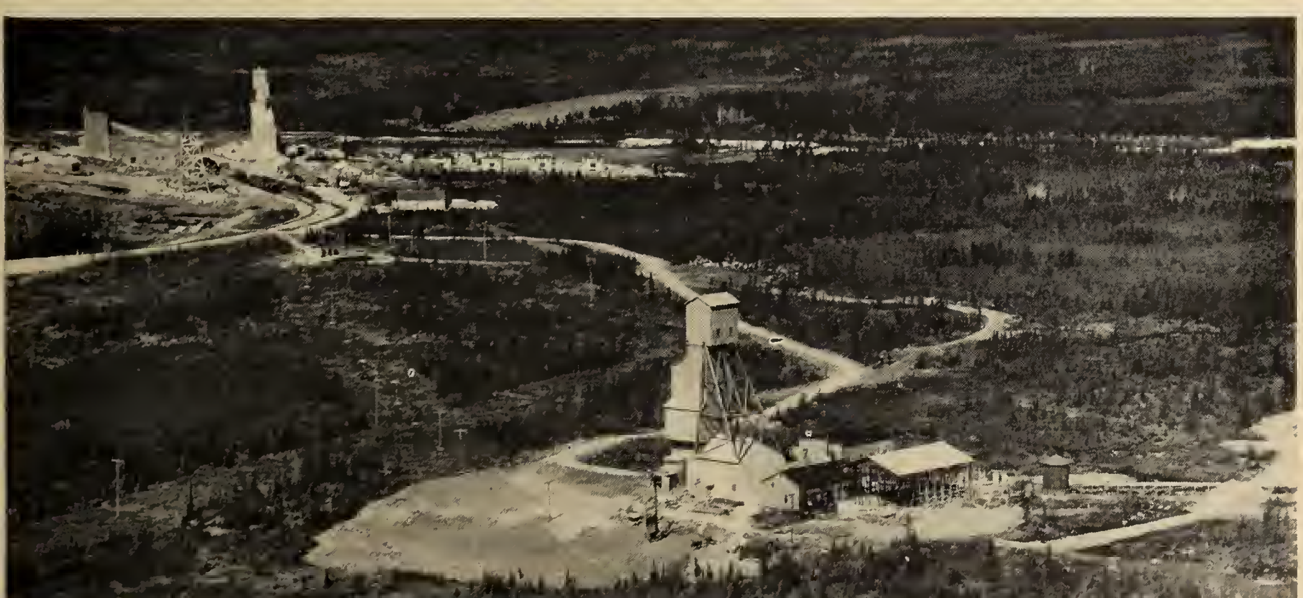
Price of titanium sponge has been cut from $5 per pound to $2.25 since 1951 and will go lower. Titanium mill products at $10/12 per pound must compete with stainless steel at about $1.00. Recent technological developments suggest its price will fall still further.

Canadian Titanium Pigments, Ltd. opened Canada's first pigment plant at Varennes, Que., late in 1957. Slag will be fed to it from Quebec Iron and Titanium's five electric furnaces at Sorel, where three more furnaces were lately added to boost capacity to 375,000 tons yearly by 1959. Baie St. Paul Titanic Iron Ore Co. produces ilmenite, and Continental Iron & Titanium Mining plans a 500-ton plant there. Several other companies have prospect in Quebec. Some 10,500 tons were produced in Canada in 1957 compared with 2300 tons last year.

Manganese

Canada is not a producer of manganese ore, but relies entirely on im-

One of the projects in the developing Chibougamau area of Quebec is the Opemiska copper mine, now expanding mill capacity.



ports from India, South Africa and Morocco. Strategic Manganese Corp. is planning an electric smelter at Woodstock, N.B. for processing low-grade manganese iron ore from its Woodstock property. Capacity will be 5,000 tons daily with annual production of 70,000 tons of 7.6% ferro manganese and 74,000 tons of ingot iron. Manganese ore imports in 1956 totalled 208,000 tons. Ferromanganese exports totalled 59,445 tons valued at over $10 million.

Magnesium

Canada ranks third after the United States and Russia in production with 19,000 tons output in 1956. As opposed to the general trend of non-ferrous metal production, output of primary magnesium in the U.S. continued at capacity during the first half of 1957, though July showed the first substantial decline. Figures for Canadian production, exports and imports of magnesium metal are not published but annual capacity amounts to some 8,000 tons, 60% from Dominion Magnesium and 40% from Magnesium Co. of Canada, an Alcan subsidiary.

Lithium

Lithium is a newcomer to Canadian mining. Some 5.4 million pounds of lithia were produced in 1957, vs. 4.8 million in 1956. To date there is only one producing company, Quebec Lithium, which with other partners has discovered the largest and richest deposits in the world. With a 1,500-ton per day mill capacity, it has a 5-year contract with Lithium Corp. of America to supply 165 tons daily of concentrates. The Company will proceed in 1958 with construction of its own lithium refinery and chemical facilities to process its lithia concentrates produced at Val d'Or, Quebec, at a cost of some $3 million. A 450-acre area has been bought at Rouses Point, in New York State just south of the Quebec/New York border, where work will be started next April.

Molybdenum

World production of molybdenum reached a new high in 1955 at an estimated 33,600 short tons of ores and concentrates of which the U.S. produced 31,000 tons. U.S. production in 1957 indicates it will compare favourably with 1956.

All Canadian production comes from Molybdenite Corporation of Canada, at Val d'Or, which in 1956 produced 707 tons of molybdenite and 117,044 pounds of bismuth metal. In 1957 the Company produced 874,600 pounds. The Company expects to mine 188,000 tons and mill 168,000 tons during the full year of 1957.

NON-METALLICS

Asbestos

Canadian asbestos production was maintained during 1957 at close to all-time record levels. Shipments totalled about 1,061,400, worth $106.4 million, up 3% over 1956. Increase in capacity in 1958 should boost shipments over the 1,064,000-ton record attained in 1955. Looking ahead, it is estimated domestic production will increase by close to 30% by 1960. Currently production and demand are about balanced, with small oversupply in a few particular grades.

Only a minor amount is consumed domestically. In 1956, 92½% or 963,921 tons of raw asbestos were exported, while manufactured asbestos articles exported were valued at $3.75 million. The United States remains by far the largest export market for raw asbestos while the United Kingdom is the second largest. West Germany, Japan, and France, in that order, come next. Top customers for manufactured asbestos articles are United States, Colombia, Mexico, Cuba, South Africa, Venezuela, Lebanon, and Syria.

Five major Quebec producers are carrying out expansion or modernization programs which will add several thousand tons of production daily next year. Potential new producers have appeared: Advocate Mines in Newfoundland is developing a 1,600 sq. mile deposit of chrysolite and is seeking financing. Cassiar Asbestos in B.C. has optioned three properties in Northern B.C. and the Yukon from Conwest Exploration.

Barite

Canada takes third place in world production of barite with the U.S. leading at 1 million tons annually and West Germany, with 400,000 ton output, only slightly ahead of Canada's 321,000 tons in 1956. For 1957, production in Canada fell to 216,000 tons. Canadian consumption is small, most of it is used in oil well drilling muds, and showed a drop in 1957 with the reduction in well drilling.

Magnet Cove Barium Corp. in Nova Scotia produces 90% of Canada's output, and owns one of the largest deposits in the world. So far it has been an open-pit production but a shaft is nearing completion.

Fluorspar

World production and consumption of fluorspar eased considerably during 1957 and the outlook is uncertain. Canadian production at 68,463 tons in 1956 was sharply down to less than a half of the record 140,000 tons mined in 1956. Almost half Canada's production is exported to the United States. Exports last year were down sharply due to suspension of operations by St. Lawrence Corp. of Newfoundland. Much of its output had been shipped in prior years to the parent Company's processing mill in Delaware.

Largest domestic consumer is the aluminum industry, with the steel trade second, which in 1955 (latest year reported) took 68,600 and 18,600 tons respectively of Canada's 88,000-ton consumption. Last fall it was announced Ottawa would hold an investigation into the tariff structure on fluorspar, but no date is set for the hearings.

Potash

Potash is used as a fertilizer. World production in 1957 was estimated at 8.2 million tons of K_2O equivalent to a mine production of 35/40 million tons. The U.S. is the largest producer and consumer. Ninety per cent of production is in New Mexico. A year ago Canada imported 90,000 pounds.

Saskatchewan's potash potential is estimated at 30 billion tons. Estimate for ore grading higher than 25% K_2O at depths less than 4,000 feet and of minable thickness is 5 billion tons. Exploration is in the hands of American companies. Potash Co. of America has a 2,000-ft. shaft on its property east of Saskatoon. Shaft sinking is slow and very expensive. For example, a 650,000-ton/year potash mine will require 3½ years to put it into production at a cost of close to $30 million. Yet Saskatchewan potash reserves are the richest known in the world and there is no doubt a great industry will develop there. To date no production has been started.

Sulphur

Threatened world shortages of sulphur of a few years ago have now been averted, mainly due to the rapid development of production in Canada. Canada's sulphur production for 1956 from all sources totalled 763,736 tons valued at $7.44 million. By end of 1960 some million tons of sulphur yearly will be available as a by-product from natural gas in Western Canada.

Production of pyrite from Canadian copper, nickel, and lead smelters has been expanding, much of it being used for the rapidly expanding uranium production in Canada. The pulp and paper industry is by far the largest consumer, with fertilizer plants a close second.

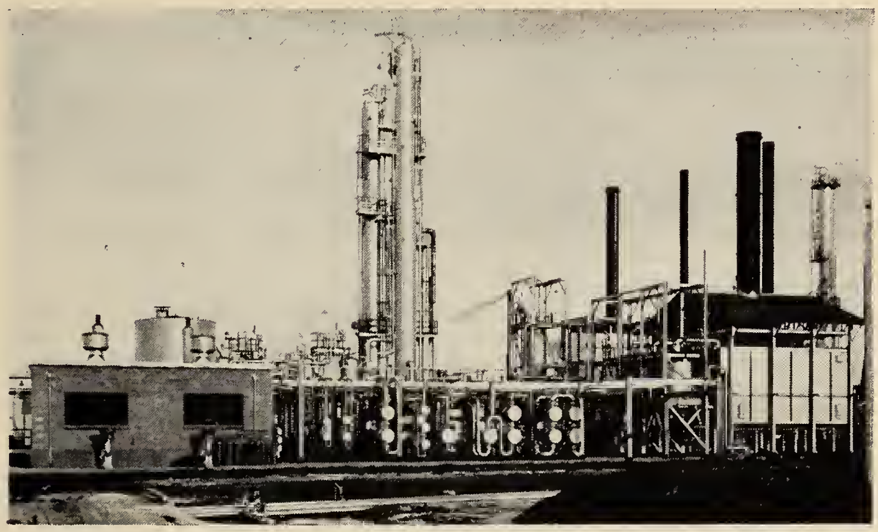
The United States is still the largest producer, turning out more than half of the free world's requirements and amounting to 7-9 million long tons in 1956. Currently, new plants in Western Canada are adding 2,100 tons daily to the 130-ton per day output a year ago from sour gas.

Other Minerals

Production of other minerals and fuels in 1957 included: gypsum 4.5 million tons, 8% lower than in 1956; salt, 1.76 million tons, up 10% over 1956; lime, 1.38 million tons, 22 per cent higher than in 1956; sand and gravel, 145 million tons, down 2½% from 1956; and coal, 13.2 million tons, down 11½ per cent below the previous year.

Table 1—1957 Value of Mineral Production by Provinces ($ Millions)

Category	Nfld.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	N.W.T. Yukon	Canada Total
Metals	71.07	0.001	5.64	188.28	595.64	33.74	77.29	0.009	129.74	34.97	1,136.41
Non-Metallic	1.85	9.02	0.67	115.73	21.24	1.23	3.97	0.92	12.65	—	167.29
Fuels	—	52.46	8.25	—	8.31	14.39	72.74	390.27	8.22	0.84	555.50
Structural Materials	3.32	3.94	8.68	80.44	114.03	11.93	7.48	20.76	24.15	—	274.74
Total—1957	76.24	65.43	23.25	384.46	739.22	61.30	161.49	411.96	174.76	35.81	2,133.94
Total—1956	84.35	66.09	18.26	422.46	650.82	67.91	122.74	411.17	203.28	37.80	2,084.55
Principal minerals produced in order of importance.	Zinc Lead Iron ore Gold Fluorspar	Coal Gypsum Salt Barite Copper	Coal Copper Lead Sand Cement Gypsum	Asbestos Copper Iron ore Gold Zinc Titanium Lithia	Nickel Uranium Copper Gold Iron ore Platinum Salt	Petroleum Nickel Copper Gold Zinc	Petroleum Uranium Copper Zinc	Petroleum Coal Nat. Gas Gravel Cement	Zinc Lead Copper Silver Asbestos Coal Tungsten	Gold Uranium Zinc Nickel	



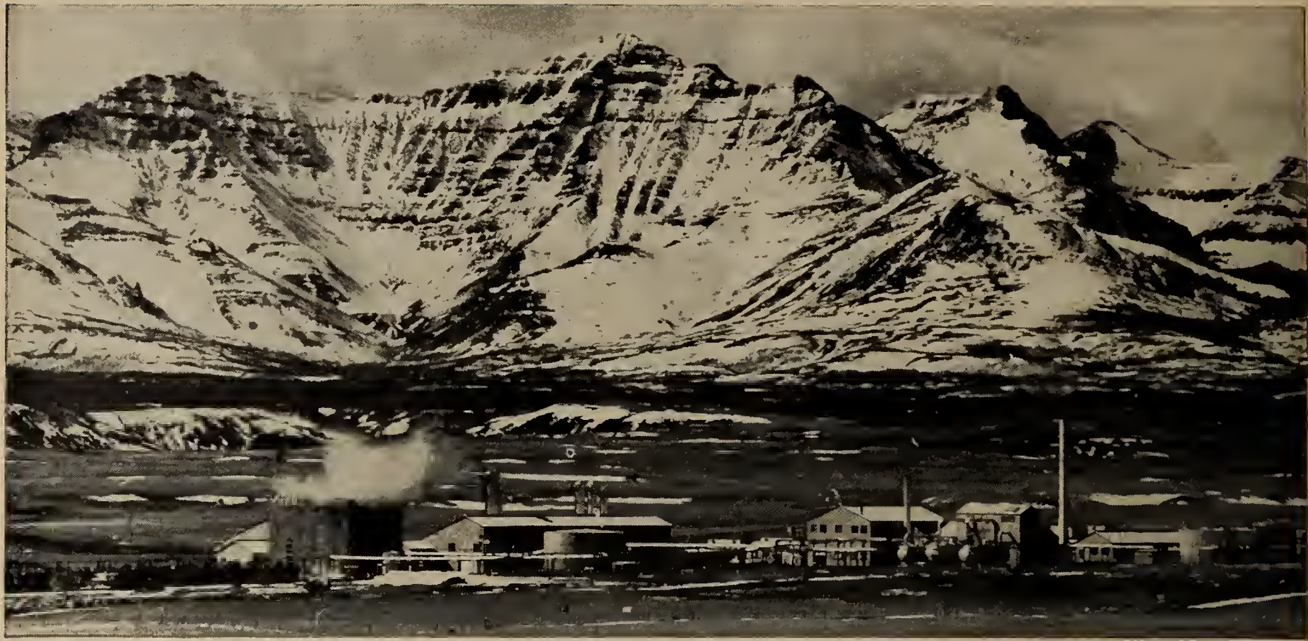
New $3-million catalytic re-forming unit at British American Oil's Edmonton refinery, used to produce high-octane gasoline.

PETROLEUM

CANADIAN PRODUCTION of crude oil in 1957 failed to record a gain similar to the 32 per cent growth recorded for each of the past two years. First hints of a flattening out of the 10 year continuous upward trend began to appear in the second quarter. By the fourth quarter output fell behind the same period of 1956 by some 2½ million barrels. Final production figures for the full year, however, are expected to show another new record at about 183 million barrels, 7% over the 171 million barrels produced in 1956. Estimated gross value of production at $444 million compares with $406.5 million in 1956.

In spite of the claims by marketing experts that the bottom had been reached in the current market slump for Alberta crude, the slower marketing pace was noticeably affecting development drilling. Producibility was at least two to three years ahead of indicated market growth and continuing to increase at the rate of some 100 new oil wells per month. The possibility that 1958 may show a further decline was raising the question at year-end of the need for proration of development drilling.

Yet nowhere was the slowdown looked upon as more than an awkward 'breathing spell'. Though development wells drilled during the year were down about 10 per cent, a record number of wildcats drilled totalled 12% more than in 1956, the success ratio holding close to the one-in-four ratio of the previous year. Footage of holes declined to about 15% below 1956, yet geophysical activity continued at a consistent pace. Only 180 drilling rigs were active at year-end, compared with 240 at the end of 1956. Total wells drilled since the Leduc discovery in 1947 numbered some 20,000 including dry wells. Though no new oil pools were discovered in 1957 comparable to the finds in Pembina or Sturgeon Lake, important discoveries were made in the Innisfail area, the Virginia Hills, Swan Hills and Edith Lake areas and in the Kaybob-Iosegun area southeast of Sturgeon Lake, all in Alberta.



The first British American Oil plant at Pincher Creek, Alberta. A second stage plant is being built. Pincher Creek will be the largest single supplier of natural gas to the Trans-Canada Pipe Line when the expansion has been completed.

Saskatchewan and B.C. Up—Manitoba Steady

Repeating the spectacular 66 per cent gain in production experienced in Saskatchewan in 1956, producers in that province recorded another 68 per cent gain in output over the previous year. Much of this gain was at the expense of Alberta producers. With her many light gravity fields in the southeast corner of the province some 800 miles nearer Ontario and mid-U.S. markets, Saskatchewan producers have captured an increasing proportion of these markets. Output for 1957 will approach 36½ million barrels.

British Columbia production for the first year exceeded 300,000 barrels, double its previous all-time total output. On the other hand Manitoba, with production of some 6 million barrels, failed to duplicate the 37% gain in output recorded there in 1956. Only a moderate gain of some 6% has been shown for 1957.

New Pattern Set on Export

The export market for Canadian crude which accounted in 1956 for a third of production, was bettered during the past year. The healthy increase in export volume of some 21% over 1956 was encouraging, but was marked by a substantial decrease in exports to the Pacific Coast and a sharp increase in exports to the northern states. The collapse during the second half of the year in the export demand for westbound oil was due to softening of tanker rates, a long refinery strike at Vancouver, and a general U.S. opposition to imports.

A realistic appraisal of all the divergent factors makes a forecast of exports for 1958 extremely hazardous. The down-trend in tanker rates, the extent to which natural gas may replace oil for heating, the possible imposition of fairly rigid import quotas across the border, and new supplies to the California market from New Mexico starting in January, cannot be intelligently weighted. But the general feeling appears to be that a levelling-off or moderate uptrend in exports of Canadian crude is to be expected during the coming year.

Temporary Cut-back

Canada's oil exports to the United States will be cut 15%, it was announced at year end. The effective cut-back will amount to only some 5%, however, and is only temporary. Back of it is a strong powerful lobby of smaller U.S. companies who feel they are being squeezed out by large oil imports.

Independents Seek Montreal Market

Many of the independent companies think Alberta producers should set their sights on the Quebec market area now served with foreign crude from the big 250,000/300,000 b/d Montreal refineries. Here is concentrated about a third of Canada's refinery capacity. Most of the major integrated companies are strongly opposing the move.

Though capture of the Montreal market for western oil would raise western Canada's output by around 25% there would have to be a cut in current wellhead prices all across Canada. Besides this, a second west-east oil pipeline could be financed only if and when the half dozen big Montreal refining companies sign long term throughput agreements to buy western oil exclusively.

The independents argue pipeline charges could be re-adjusted upwards for intermediate delivery points such as Toronto and Sarnia to permit a 10c lower rate to Montreal. They also advocate a 10c customs tariff on foreign oil at Montreal. These adjustments, plus a 10% cut in wellhead prices would make western oil competitive with Mid-East oil in the Montreal market. But integrated companies foresee an assurance of price cuts by the present suppliers of ocean-borne crude. They also look for a bigger potential market in the United States within five to seven years. They believe it better for western producers to wait for this certain market rather than to cut wellhead prices and gain the Montreal market.

Oil Pipe Mileage Substantial

Although the mileage of crude oil pipelines laid during the year was small compared with gas pipelines, more than 800 miles were laid, including 156 miles of new 20-inch line for Interprovincial Pipeline Co. in Ontario from Sarnia to Port Credit outside of Toronto. The balance was entirely looping programs designed to provide in advance for expected increases in throughput for strategic regions. Trans-Mountain's main pipeline was looped for 100 miles with 30-inch, Westspur laid a 75-mile 16-inch loop in Saskatchewan, the Pembina Pipeline main was looped for 36 miles and Interprovincial looped 33 miles with 24-inch in Saskatchewan.

Westcoast Transmission is considering the building of a 650-mile 'big-inch' crude pipeline from Peace River fields to Vancouver, paralleling the company's natural gas pipeline, though the project may be two years away due to the softness in the current market for crude on the Pacific Coast. Pacific Petroleums is also interested, due to its development in the Boundary Creek, Fort St. John, and Buick Creek fields which the line would tap. A similar line is planned to Bella-Coola by Act Oils Ltd., which is owned by Canada Southern Petroleums and others.

Wells Completed and Footage Drilled—Four Western Provinces (12 months, 1957)

		Oil	Gas	Dry	SWD	Total	Footage Drilled
B.C.	Devel.	8	31	16	—	55	519,878
	Wildcat	4	13	19	—	35	
Alta.	Devel.	838	105	111	9	1,063	7,447,579
	Wildcat	37	35	282	—	354	
Sask.	Devel.	844	13	95	9	961	5,300,329
	Wildcat	28	1	241	—	270	
Man.	Devel.	132	—	20	8	160	516,433
	Wildcat	—	—	64	—	64	
West Prov.	Devel.	1,822	149	242	26	2,239	13,814,219
	Wildcat	69	42	606	—	724	

Developments Down-North

A 250-mile crude oil pipeline will be built by Bituminous Oil Pipeline Co. Ltd., a company recently formed to transport oil from the oil sands area in north eastern Alberta to Edmonton. The Company is jointly owned by Royalite Oil and Can-America Oil Sands Development Ltd., partners in the $50 million project announced last year. The Coulson process using centrifugal force to bring commercial production will be used. Size of the pipe is not yet determined.

British interest in the oil sands is reaching the stage of definite planning. A committee has been set up in the U. K. to make a long term study. Largely undisclosed U.K. interests are expected to announce development plans in a few months. The British government, interested mainly from the point of view of world strategy, looks to development of a major energy source should it lose the big Mid-East oil fields.

The oil refining and distribution project for the Northern B.C.-Yukon-Alaska area is moving closer to reality with financing of Alaska-Yukon Pipelines Ltd. Properties and facilities at Haines and Whitehorse of Alaska Yukon Refiners & Distributors, now used for marketing in the Yukon for trucking of products from tidewater at Haines, will be acquired by the pipeline company.

This Shell Oil Company of Canada alkylation plant at Montreal East, Que., will produce alkylate for gasoline and heavier types for detergent manufacture.

Refinery Capacity Up Moderately

Canadian refinery capacity moved up to 724,550 b/d in 1957, an increase of some 67,000 b/d over capacity at the end of 1956. Cracking capacity at some 336,000 b/d was reduced by 6,600 b/d during the same period. Present crude refining capacity in b/d is divided as follows: Maritime provinces, 45,000; Quebec, 260,800; Ontario, 207,500; Prairie provinces, 192,000; British Columbia, 68,000; and N.W.T. 1,300.

Cities Service Oil Co. and Shell are each adding 20,000 b/d capacity at Bronte near Toronto over the next two years. The shifting over of a now-operating Sarnia refinery to western crude will boost further the west's share of the Canadian market. Construction will begin this spring on rebuilding and expansion of Imperial's Calgary refinery for completion in 1959, adding 6,700 b/d to capacity. Shell's Shellburn refinery at Vancouver will expand for production of a wide variety of solvents, while North Star Oil has just completed arrangements for addition of catalytic reforming at St. Boniface, Manitoba.

Refined Products

With a modest increase in refinery capacity during the year 1957 of some 67,000 barrels per day, total runs to stills of some 206.5 million barrels of all refinery products during the first 10 months of 1957 was 5 per cent higher than for the same period in 1956.

During the full year 1956, Canadian refineries received 234.3 million barrels of crude oil and natural gas liquids, 65% of it from Canadian sources and 35% in imports. Total runs to stills amounted to 234.3 million barrels. Refineries in various areas received raw materials in millions of barrels as follows: B.C. 21.9; Alberta and N.W.T., 27.9; Saskatchewan, 18.2; Manitoba, 9.9; Ontario, 58.4; Maritimes and Quebec, 96.2.

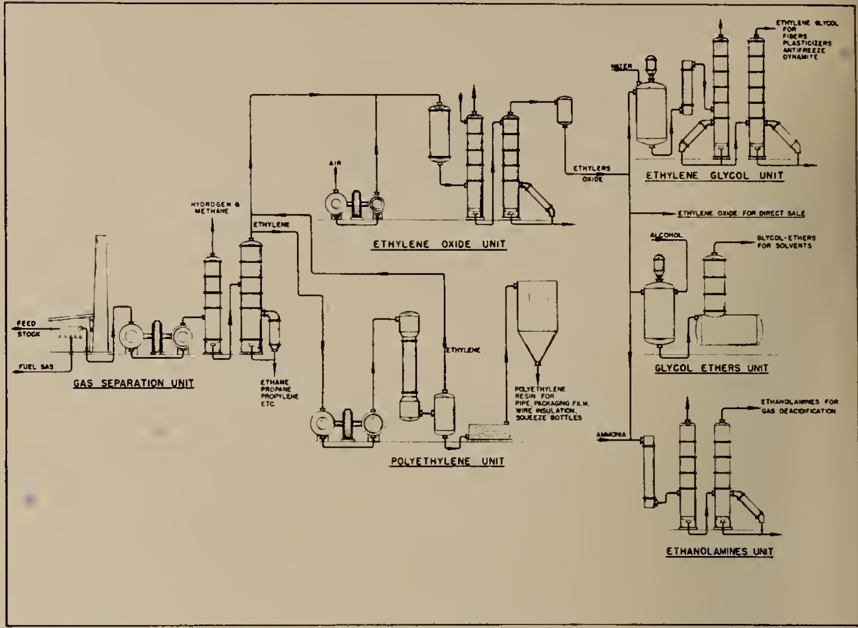
For the year 1956, net sales of finished petroleum products in Canada from all Canadian refineries, in millions of barrels of 35 Imperial gallon capacity, were as follows: liquefied petroleum gas, 3.7; feed stocks, 2.1; naphtha specialties, 1.3; aviation gasoline, 3.9; motor gasoline, 83.0; tractor fuel, 0.12; aviation turbo-fuel, 3.16; kerosene and stove oil, 16.0; diesel fuel oil, 18.9; light fuel oil, 46.5; heavy fuel oil, 50.5; asphalt, 8.05; coke, 2.7; lubricating oils and greases, 3.0; wax and candles, 0.28; still gas, 0.1; other products, 0.66. Total all products, 244.1; unfinished products, 0.04.

Petrochemical Industry's Growth

Petrochemicals continued to expand in 1957 at a rate unparalleled in recent years by any other industry. By 1957 Canada had 24 plants, involving a capital outlay of more than $300 million. Further plants now being planned represent a further investment of close to $100 million. Thus they have been mainly based on crude oil hydrocarbons. But the current development of natural gas will bring about a great expansion in petrochemical manufacture.

In 1957 only two percent of crude oil and natural gas production in North America was going into Petrochemicals. That year, nearly 20 separate projects for production of primary raw materials were under way or announced for early construction in Canada.

Since the discovery 11 years ago of large reserves of oil and gas in Western Canada, growth of petrochemicals and their derivatives has been greater relative to local population there than it has in eastern Canada. But availability of raw materials in eastern provinces from crude oil at low cost, in spite of the long haul distances involved, suggest that petrochemical industries will flourish and grow faster in Ontario and Quebec than in the prairie provinces.



A simplified flow program of the processes and products in a petrochemical plant.

NATURAL GAS

In sharp contrast to the oil industry's failure to set the usual new production record in 1957, the natural gas industry looks back on 1957 as a year of spectacular accomplishments. Eight months production at 206.2 billion cubic feet was 22% over the 169.2 billion cu. ft. produced in 1956.

With completion of the Westcoast Transmissions system in October, Peace River gas deliveries commenced to customers through the completed distribution systems in mainland British Columbia communities served by Inland Natural Gas Co. Canadian gas replaced imported gas in the Vancouver area and reversed the northward flow by feeding Canadian gas into the Pacific Northwest Pipeline

Station No. 1 on the Westcoast Transmission Company's line at Fort St. John, B.C.

south of the International Boundary.

To the east, Trans Canada completed its 34-inch western leg as far as Winnipeg by the early September, and gas deliveries to Regina, Brandon, Portage la Prairie, and Winnipeg commenced by the end of the same month. The pipeline was completed to the Ontario border by late in October. The long open fall weather permitted the Northern Ontario Crown Corporation finally to reach Fort William-Port Arthur with its 310-mile 30-inch pipeline by the first week in December. By year end Alberta gas was available through 910 miles of line from Alberta gas fields to Lakehead cities.

Still further east, Trans Canada's 20-inch diameter section between Toronto and Montreal was completed to the Island of Montreal, as well as branches to serve Lindsay and the Ottawa-Hull area, awaiting a temporary supply of borrowed gas from the Dawn Township Storage fields of Union Gas Co.

In Southwestern Ontario, Union Gas was close to completion of its 142-mile main pipeline from Dawn Township to Hamilton and to connect up with the Toronto-Montreal leg of the Trans Canada Pipeline.

Second Pipeline by 1962?

Thus with natural gas available to most of the important centres across Canada, with exception of those between Lakehead and Toronto, and distribution systems in various stages of completion, a serious re-appraisal of Canada's export position is called for. The indicated rapid market build-up in Eastern Canada and on the West coast has even exceeded earlier expectations. A maximum throughput rate, including export, of some 650 million cubic feet daily within four or five years is considered not only possible but practically certain.

This means both Westcoast and Trans Canada must have vast looping programs under way by that time to provide added capacity for the next round of expansion. This in turn calls for more development of gas fields, the proving up of further gas reserves, and federal and provincial approval for the movement of further gas to these markets.

Several of the large gas distributing companies have forecast that within a year they will be in the market for 1963 contract volume increases ranging from 40 per cent upward. Besides this are the potential fuel and raw material needs for large industrial, metallurgical and petrochemical application. Top iron-ore and

A view during construction of the Interprovincial Oil pipeline in Manitoba.

The platformer at the Shellburn refinery near Vancouver will supply feedstock for new solvent facilities to be constructed during 1958.

steel firms have their eyes on direct ore - to - sheet - steel operations for Northern Ontario based on a new process recently discovered by a Canadian metallurgist.

Export Permits Granted and Sought

Trans Canada has an export permit from the Alberta government for 4.35 trillion cubic feet, subject to a daily limitation of 650 million cubic feet. It now appears these peak requirements will be met as early as 1961-62. Westcoast Transmission, with government approval for a throughput of 660 million c.f.d., 83% of which is exported, applied early in 1957 for permits to increase its exports by 170 million feet daily from Savanna Creek field in Southwestern Alberta. Alberta and Southern Gas. Co. seeks permission to export 450 million c.f.d. to the California market through a 1,300-mile pipeline via the Crow's Nest Pass costing $330 million. Competition among Westcoast and Canada

Southern is stiffening wellhead prices and forcing Trans Canada back into the gas buying role in Alberta.

Toronto, Vancouver Set the Pace

The best measure of the popular appeal and rapid acceptance of natural gas as a Canadian fuel is evidenced by the experience of Consumers' Gas of Toronto and of British Columbia Electric, the first two utilities to distribute gas from the new pipelines. Consumers' Gas Co. showed a net profit of $1.18 a share for fiscal year ending Sept. 30, 1957, a 46% improvement over the previous year despite major rate reductions. In the 1956-57 heating season, 30,000 houses were heated with natural gas compared with 4,000 the previous winter, while almost 15 billion cubic feet had been sold in the full fiscal year, up 63% over the previous year. Some 300 miles of distribution lines were laid in 1957.

British Columbia Electric reports that sales of gas appliances have vastly exceeded the sale of electrical appliances since natural gas was first delivered late in 1956. Furthermore, president A. E. Grauer announced at the time Canadian natural gas reached Vancouver that his company would purchase Peace River gas for a giant new thermal power plant. The contract will call for 144 million c.f.d. and the gas will replace much of the heavy electric demand in the lower mainland area of B. C. These are reasons why West Coast's president, Frank McMahon, speaks confidently of a second parallel pipeline from the Peace River area.

The Borden Commission

Appointment of the Royal Commission (The Borden Commission) by Prime Minister Diefenbaker in October '57 to study the whole Canadian energy picture was considered long overdue. It will make recommendations on gas export policy and the need for government controls to safeguard public interests. It may delay approval of Trans Canada's standing gas-export contract with Mid-Western Gas Transmission, promised by the former Liberal government.

The Prime Minister's first declaration of November 1st on gas export policy, that no action would be taken on applications for export permits until the Borden Commission had made its report, was a shock to pipeline and gas producers and gas company officials. U. S. Utility and pipeline officials and Canadian natural gas producers were deeply disappointed at the implied long deferment of any further export business.

Indignation of the whole Canadian natural gas industry found expression in November in three addresses by leading oil and pipeline company executive officers. They demanded that the Commission should get on with investigation of the gas phase of its study right away, and bring in an early interim recommendation on export.

Reserves and their Allocations

Western Canada's gas reserves are placed today at anywhere from 25 to 28 trillion cubic feet, of which 18.3 trillion are in Alberta. Alberta's 30-year requirements are estimated at 7½ trillion feet, and approved exports to other provinces and to the U. S. are 5.75 trillion feet, leaving a present surplus of 5 trillion feet. It is estimated that reserves are increasing at the rate of two to three trillion feet yearly, most of it incidental to the search for oil. Recent major discoveries in Alberta's southwestern foothills and at East Calgary and Crossfield have added tremendously to reserves. The big Pembina oilfield will also be a large gas producer once facilities are completed to make use of flare gas. Some gas authorities claim reserves will grow at a rate of 12-15 per cent yearly, which would mean reserves of 60 million cubic feet by 1967.

The search for natural gas to supply the various pipeline systems, completed and proposed, has spread to most of the areas tributary to them within the provinces of British Columbia and Alberta. Almost every active company has had a part, large or small, in the exploration and development. Pacific Petroleums has played the major role in the Peace River and Fort St. John fields that supply West coast transmission. Prominent among the groups that will supply Trans Canada stand Canadian Delhi, British American Oil, Shell Oil, and Provo Gas.

Active in the exploration and development of gas fields for supplying the second westcoast project from Savanna Creek were Phillips Petroleum and Canadian Husky. Gas fields tributary to the proposed Canada Southern project include reserves of Canadian Western Natural Gas Co.; a 500-mile gathering line is envisaged from the Fort St. John area through Pembina and Sundre, with possibly the south half of British American's Pincher Creek field. The East Calgary field, discovered by Jefferson Lake Sulphur Co. and Merrill Petroleums, would also be tied in, as well as the recent Texaco foothill discovery at Castle River and the Shell Waterton find north west of Pincher Creek field.

Gordon Report Discusses Energy

As the year 1957 drew to a close, attention of the entire Canadian petroleum industry was being focussed on the report of the Gordon Commission on 'Canada's Economic Prospects'. Prepared for the Commission by Dr. John Davis and released in December, it provided a new perspective on the advantages and limitations of energy export. 'Countries or provinces that put energy to work effectively, rather than those that produce the most energy, are the ones that win the most of the rewards. From this it follows', states the report, 'that Canada will benefit from development of its energy sources, but it will benefit more if a growing proportion of that energy can be put to work at home'. This, of course, did not mean refusing to export energy we cannot use in Canada now or in the future.

According to the report, by 1980 Canada will be using three times as much energy as in 1955. We will use three times as much oil, eighteen times as much gas, four times as much water power, and twice as much coal. Atomic power will furnish about two per cent of our total energy.

Davis, making this report for Gordon, has assumed the wellhead price for gas will double in the next 25 years. He draws the conclusion that export of gas is not very beneficial, that perhaps it would be better to hold gas in the ground until more of it can be used in Canada.

Editorially, *Oil in Canada* points out that "the basic fallacy in this reasoning is the assumption that there is any advantage in holding on to an expendible commodity in the hopes of an ultimate price rise. This was done very effectively by John MacFarland with wheat in the early 'thirties'—so effectively that Canada has not yet recovered some of the lost markets".

"Energy demand cannot be stored up. It has to be satisfied from some source . . . Few companies in the petroleum industry can afford to hold producible hydrocarbons for ten to twenty years for a possible but not guaranteed price rise if an immediate market is offered at a lower return . . . a great deal of independent study is called for."

The New Brunswick Electric Power Commission's 102,000-kw. hydro-electric development on the St. John River, under construction for three years.

POWER
PRODUCTION AND DISTRIBUTION

CONSTRUCTION of hydro-electric plants in Canada continued to accelerate during 1957 as a result of increasing power demands. The 1,501,560 h.p. of new capacity added during the year represents the second highest annual increase to date. Other installations currently under construction are expected to add about 2,200,000 h.p. of new capacity during 1958 and more than 4,300,000 h.p. in the succeeding few years.

There are also several sites with large potential capacities, which are currently under investigation and on which it is probable that development will be undertaken within a few years' time. The total installed capacity of water-power plants in Canada is now listed at 19,871,000 h.p. which, however, represents less than 28% of total resources.

In addition to hydro-electric developments, the building of new thermal-electric plants and extensions was increasing in some areas of the country; construction of main transmission lines, distribution lines and substation capacity also proceeded vigorously during the year.

If installed thermal capacity of some 3 million h.p. is added, the grand total is more than 23 million h.p. A review of the year's activities both by utilities and by industrial establishments for each province is shown in Table 1. (Page 66)

BRITISH COLUMBIA

In British Columbia a total of 607,500 h.p. of new capacity was installed during the year, the highest among the provinces. An additional 192,000 h.p. is under construction for 1958 operation and more is in the planning or early development stages.

The B.C. Power Commission completed installation at Ladore Falls of the second of two units, each consisting of a 35,000 h.p. turbine. The Commission is also proceeding with its Upper Campbell Lake development, where the initial installation of 42,000 h.p. will be in service by May 1958. Here, a huge earth-fill dam will store water in both Upper Campbell and Buttle Lakes for use in all three Campbell River plants. The Quinsam diversion has been completed, while two more diversions are under way.

Additional construction on Vancouver Island included the commencement of a development on the Ash River near Port Alberni. The water will be conducted five miles from Elsie Lake to the powerhouse on the north shore of Great Central Lake. Here a 35,000 h.p. turbine will be installed for service by March 1959. Development on the mainland included a third unit at the Whatshan development, comprising a 16,500 h.p. reaction-type turbine completed in January 1957.

In addition, three developments are in active prospect: two in the Alberni area of Vancouver Island, with potentials of 35,000 h.p. and 17,000 h.p. respectively, and the third on the Kokish River in upper Vancouver Island, with a potential of 51,500 h.p. Four additional possible developments are under active study and investigation by the Commission: one on Vancouver Island with a potential of 81,500 h.p. on the Nimpkish River, the remaining three on the mainland. These are: a development of up to 1,900,000 h.p. by diverting water from the Chilko to the Homathko Rivers, a second development on the Murtle River, tributary to the Clearwater, with a potential of 140,000 h.p. and the third, also in the Clearwater system, with a potential of 120,000 h.p.

In the thermal-electric field, the Commission completed installation at its Georgia gas turbine plant at Chemainus, of the first two simple cycle 26,500 h.p. gas turbine units.

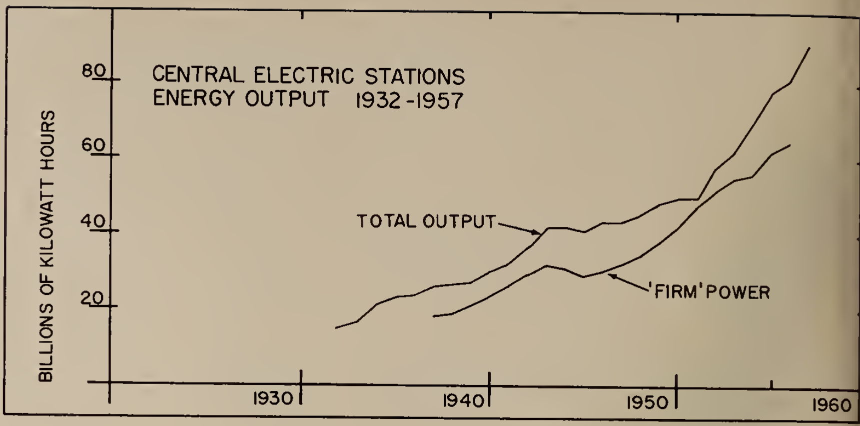


Table I—Power Installation for 1957, 1958, 1959 and Planned for Future Years

	Installed 1957 Hydro h.p.	Installed 1957 Thermal kw.	Scheduled for 1958 Hydro h.p.	Scheduled for 1958 Thermal kw.	Scheduled for 1959 Hydro h.p.	Scheduled for 1959 Thermal kw.	Planned for Future Hydro h.p.	Planned for Future Thermal kw.	Notes
British Columbia.....	607,500	70,000	192,000	92,000	391,000	—	2,300,000	1,200,000	(1)
Alberta.............	23,000	4,250	—	73,500	102,000	—	—	—	
Saskatchewan........	—	41,000	—	—	19,000	—	—	—	
Manitoba...........	7,000	66,000	—	—	—	132,000	168,000	—	
Ontario.............	335,000	—	1,010,000	—	460,000	—	360,000	800,000	
Quebec.............	474,000	—	900,000	—	728,000	—	2,905,000	—	(2)
New Brunswick......	45,000	—	45,000	—	—	50,000	—	—	
Nova Scotia.........	5,300	45,000	4,000	—	—	36,000	6,500	—	
Prince Edward Island	—	—	—	—	—	—	—	—	
Newfoundland.......	1,200	—	35,000	—	—	—	414,000	—	(3)
Yukon-N.W.T.......	3,000	—	15,000	—	—	—	—	—	(4)
TOTAL.............	1,501,500	226,000	2,200,000	165,500	1,700,000	218,000	6,153,000	2,000,000	

(1) Excluding Mica Dam and diversion of Columbia.
(2) Excluding Lachine development.
(3) Excluding 4 million h.p. at Grand Falls.
(4) Excluding 4 million h.p. in Yukon.

Currently being added to this plant are two regenerative cycle 24,000 h.p. gas turbine units, for operation by July 1958.

Current additions to tri-fuel internal combustion engine and diesel plants at Dawson Creek, Prince George, Tofino, Quesnel, Terrace, and Fort St. James will bring total capacity of these plants to 11,000 kw., 12,000 kw., 4,200 kw., and 1,250 kw., respectively.

The British Columbia Electric Company started operation of its Cheakamus development in October when the first of two 95,000 h.p. units was brought into service. The development at Clowhom Falls on Sechelt Peninsula was rebuilt and the 4,000 h.p. two-unit installation replaced by a single unit consisting of a 40,000 h.p. turbine. The concrete gravity dam was raised to a maximum height of 71 feet. The plant was to go into operation in December 1957.

On the Company's Bridge River system, the power plant at the La Joie dam commenced operation in November when a 30,000 h.p. turbine and 24,500 kva. generator were placed in service. Work was continued on the final phase of the Bridge River development involving a large storage dam, a second tunnel through Mission Mountain and a new powerhouse on Seton Lake. The storage dam will provide an additional 750,000 acre-feet of storage, and is expected to increase the total capacity from 248,000 h.p. to 276,000 h.p.

At the Bridge River No. 2 development, four 82,000 h.p. units are expected to be installed during the latter half of 1959, which will provide a total installed capacity of 328,000 h.p.

In addition to its hydro-electric installations, the British Columbia Electric Company started construction of a 122,000 kw. gas turbine plant at Port Mann. The four units will be capable of operating on either oil or natural gas fuel and are scheduled for operation late in 1958. At Ioco, on Burrard Inlet, land acquisition negotiations for government permits were initiated for a large steam plant of six units, each rated at 210,000 h.p. The first unit will go into operation in January 1961.

The Aluminum Company of Canada Limited installed the fifth and sixth units, each of 150,000 h.p. in its Kemano plant, bringing the total capacity to 900,000 h.p. A seventh unit, also of 150,000 h.p. may be installed early in 1958. Alaska Pine and Cellulose Limited installed a 7,500 kw. double extraction condensing steam turbine, at its mill at Port Alice, British Columbia.

Consolidated Mining and Smelting (Cominco) started field investigation at the second power site on the Pend d'Oreille River six miles upstream from its Waneta plant.

The City of Nelson completed several additions to its substations. East Kootenay Power constructed two miles of 66 kv. transmission line and 21 miles of rural lines, while the Wenner-Gren Foundation commenced preliminary investigations of the water power potential in the Rocky Mountain Trench area of the Peace River, and will continue this work in 1958.

Kilowatts or Fish from the Fraser?

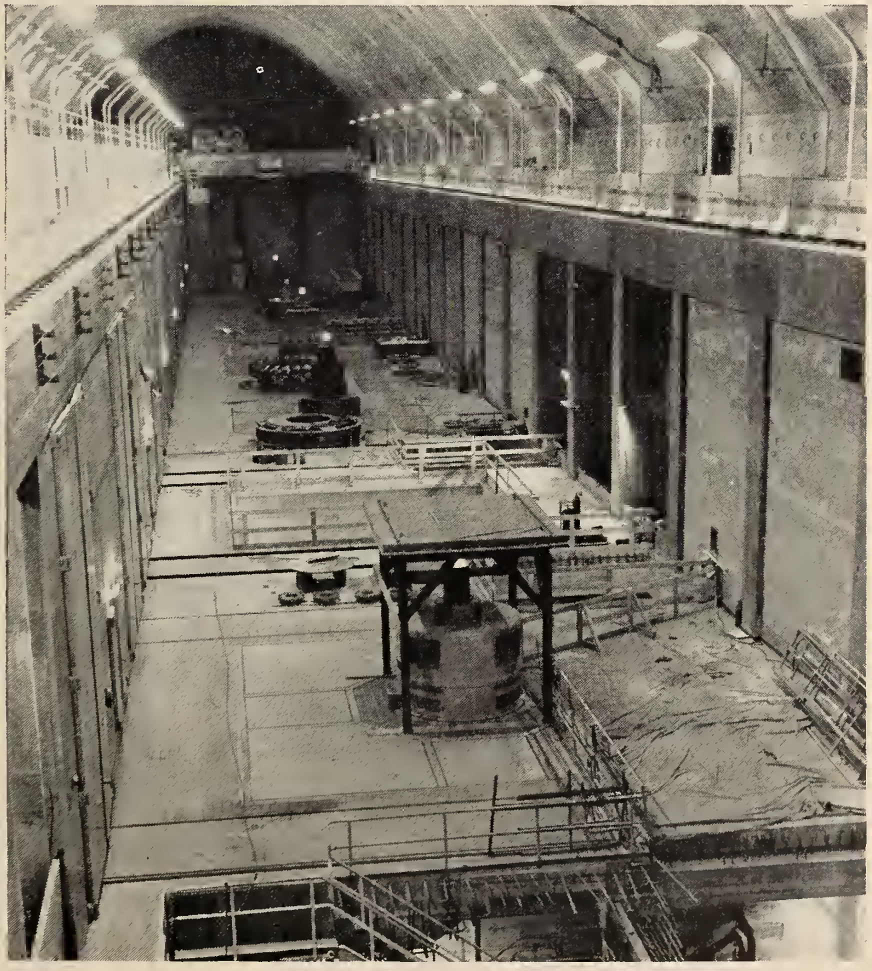
General A. G. L. MacNaughton, chairman of the Canadian Section of the International Joint Commission, told the Canadian Parliament in December that harnessing of the Fraser

River (feasible only by increasing low flow) was the only way to provide cheap power for British Columbia; that each day's delay in a decision increases the chances that B.C. power resources may come under control of the United States.

Tremendous pressure was building up in the U.S., he said, to permit the U.S. financed dams on the upper Columbia river to provide water for lower Columbia power plants. This was indicative of the widening breach between the two countries over the ultimate development of the Columbia. "Fish must take a back seat," he warned.

Fishing interests claim dams on the Fraser would wreck the $45 million yearly salmon fishing industry. Officials of the provincial government are known to prefer development of the Columbia with the United States before the Fraser is dammed.

Power developments in British Columbia include the new Cheakamus hydro-electric station, above. A sixth generator operated in 1957 at Kemano, and a seventh was built.



ALBERTA

Calgary Power Limited placed in service in October a second 23,000 h.p. unit at its Cascades plant, which operates under a head of 320 feet. The Company has begun construction of extensions to its two plants in the Spray Lakes development, to double capacity. Both are scheduled for completion in October 1959. In thermal power development, the Company is adding to its Wabamun plant a second 66,000 kw. unit for operation in October 1958. Thermal installations in Alberta during the year also included a 1,250 kw. gas unit by Northland Utilities at Jasper, a 3,000 kw. gas turbine unit for operation early in 1958. City of Lethbridge was installing a new 7,500 kw. gas turbine generating unit in its steam plant for operation early in 1958.

SASKATCHEWAN

The Hudson Bay Mining and Smelting Company plans to add a 19,000 h.p. stand-by unit to the Churchill River Power Company plant at Island Falls. Construction of the unit will be started in 1958 with a view to operation early in 1959.

The Saskatchewan Power Corporation at present depends exclusively on thermal units for power. During the year it added a 30,000 kw. unit to its Estevan plant, an 8,000 kw. unit to its Kindersley plant, and a 3,000 kw. unit to its plant at Swift Current.

MANITOBA

The Manitoba Hydro-Electric Board was proceeding with its development on the Nelson River at Grand Rapid, 400 miles north of Winnipeg, for the International Nickel Development at Moak, Mystery, and Thompson Lakes. The initial installation will comprise four 42,000 h.p. propeller-type turbines under normal head of 50 feet. Two units are scheduled for operation by July 1960, and the remaining two by January 1961. Additional features include the excavation of a channel to divert the entire flow of the Nelson River around Grand Rapid, and of a permanent dam which will provide a mean head of 55 feet. Other work includes a cantilever bridge across the river at Grand Rapid, and 14 miles of railway track between the site and the C.N.R. line at Mile 256.

At the Board's steam-electric plant at Brandon, the first two 33,000 kw. generator units were to start operation in December 1957 and the remaining two in the autumn of 1958. At the Selkirk thermal station two 66,000 kw. generator units are scheduled for initial operation late in 1959. The Board's program of present and proposed generation and transmission is designed to handle expected power demands up to and including the winter of 1961-62.

Sherritt-Gordon Mines had completed its Laurie River No. 2 development consisting of one 7,000 h.p. Francis turbine under a head of 55 feet. This plant is connected to the downstream No. 1 plant by 5 miles of 69 kv. transmission line and is to be automatically controlled from that plant.

The City of Winnipeg is continuing with the renovation of its Pointe du Bois hydro station and made repairs to the spillway and sluice gates at the Slave Falls station, both on the Winnipeg River. The Department of National Defence at Churchill maintains a 2,100 kw. diesel. Construction is under way for a 1,136 kw. addition.

The B.C. Power Commission's 100,000-h.p. Georgia generating station, above, is the world's largest gas turbine installation. Another of the Commission's projects is the Upper Campbell earthfill dam, 1700 feet long and 175 feet high, which will turn the Upper Campbell and Buttle Lakes into a 30-mile stretch of water. The first 42,000-h.p. generating unit will go into service during 1958.

ONTARIO

Demands for power in past years have resulted in an intensive program by The Hydro-Electric Power Commission of Ontario, and growth in power requirements has been met. Major work during 1957 included developments at the St. Lawrence Power Project, at Sir Adam Beck-Niagara Generating Station No. 2, and at six projects in northwestern Ontario. The Commission also completed a canal and control works for the diversion of water from Lake St. Joseph in the Albany River drainage to lac Seul in the English River drainage via the Root River.

Seaway Power

The St. Lawrence power project, a joint development of the International Rapids Section, was begun in August 1954. The main features include two adjoining powerhouses which form an integral part of a gravity-type dam structure, a dam at Long Sault to control the level of the headpond, a dam at Iroquois Point to regulate flow from Lake Ontario, and some 14 miles of dyke. Other work included a heavy program of channel improvement and excavation, the relocation of highways, railways, transmission facilities, and the design and construction of new townsites. (See 'Construction'.)

At Niagara Falls

At the Sir Adam Beck-Niagara Generating Station No. 2, at Niagara, the Commission amended its program in 1953 to provide for an associated pumping-generating station and four additional units at the main station. By the end of 1957 work on both these projects was well advanced, and two of the additional units were placed in service in December. The final two will be placed in service in May and July of 1958 respectively.

Each unit has a rated capacity of

105,000 h.p. At the pumping-generating station three units of the six were placed in service late in 1957. During periods of low demand the units will pump water diverted from the main power canal into a reservoir having a capacity of some 16,000 acre-feet. In periods of high demand they will operate in reverse as turbines, each unit having a capacity of 47,000 h.p. Flow from the reservoir in turn will augment the flow in the power canal and thus increase the output of the units in the main generating station. Installation and assembly of the generators for the three remaining units progressed favourably. They will be in service in the spring of 1958.

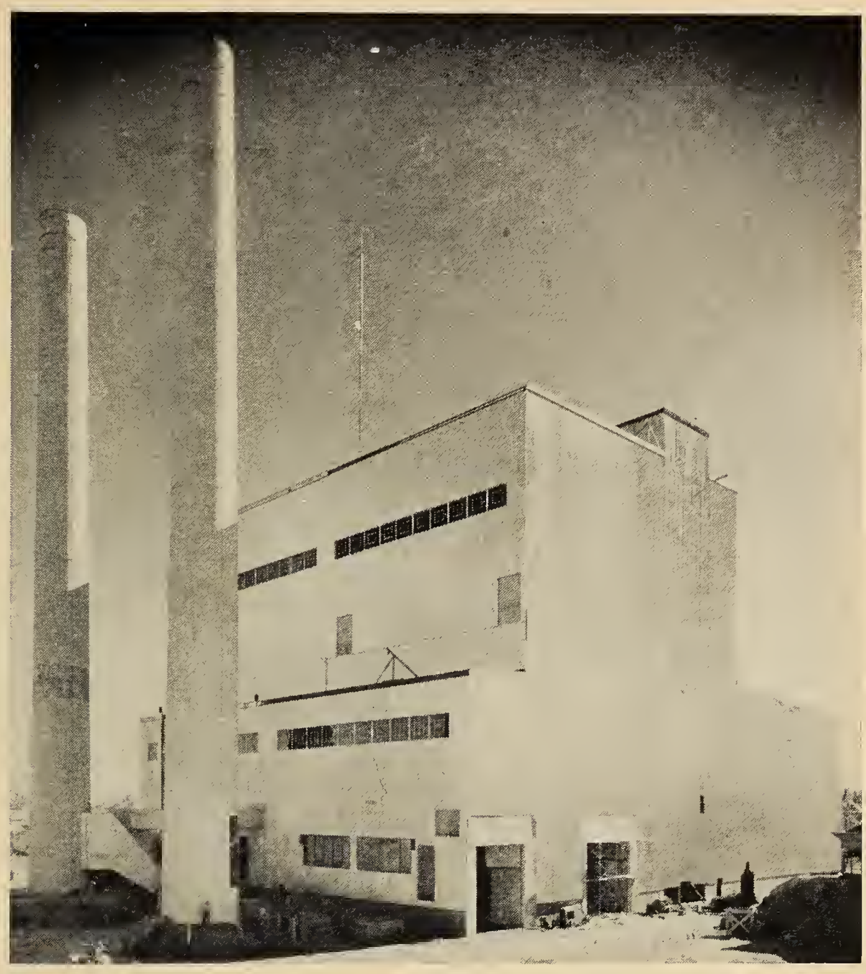
A control dam in the Niagara River about a mile upstream from the falls was completed last year and the last four gates were placed in operation. Other portions of the remedial works program involved the excavation of certain areas of the river-bed and the placing of fill on the United States side of the river, which was carried out by United States Army Engineers in 1954, and similar work on the Canadian side carried out by the Commission in 1955.

Developments in Northwestern Ontario

The development of Whitedog Falls on the Winnipeg River was started in 1955 and considerable preparatory work was carried out in 1956. Total turbine capacity will be 81,000 h.p. and initial service is scheduled for February 1958. By the end of the year the dam, the south bulkhead, gate sluices, log-chute head-block, and a compacted earth-fill wing dam had been completed. Mechanical equipment for sluice-gates was installed. Concrete placing in the powerhouse structure was completed and work crews had begun erection of turbines and generators.

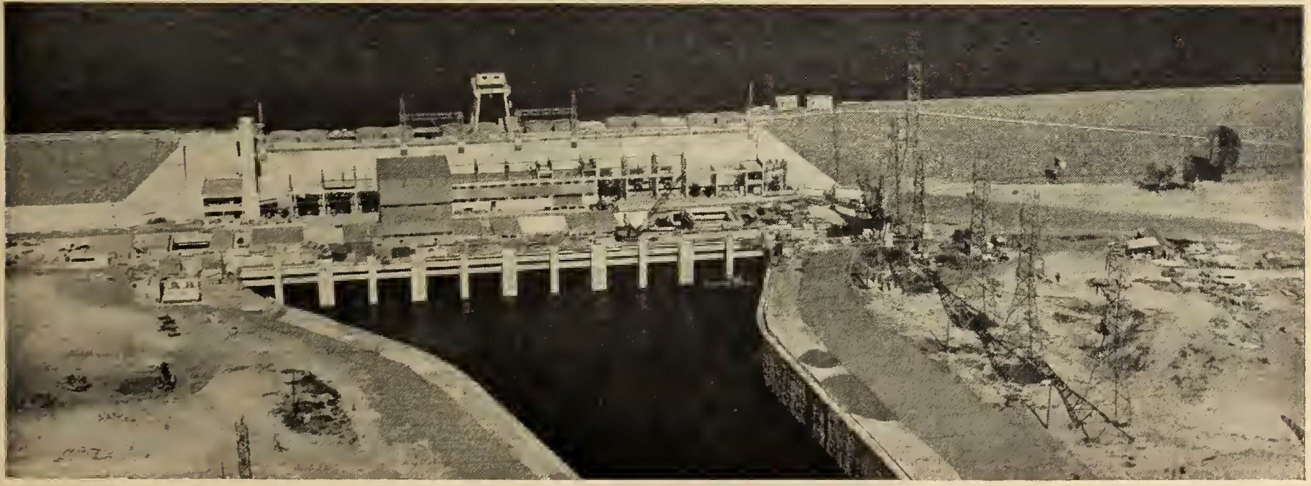
The Caribou Falls generating station was begun in 1956. Located on the English River 17 miles northeast from Whitedog Falls, its three units, which will total 102,000 h.p., are scheduled for service by October 1958. In addition to this work, four auxiliary block dams were built to assist in containing the headpond.

At the Manitou Falls generating station, provision for a fifth unit was made in the headworks in the event of increases in loads in the northwestern section of the province. In the spring of 1957 the Commission began work on an additional 18,500 h.p. unit, and such excellent progress



The Wabamun power plant of the Calgary Power Limited, showing the new stack and extension to the plant which will house a second 66,000-kw. generating unit.

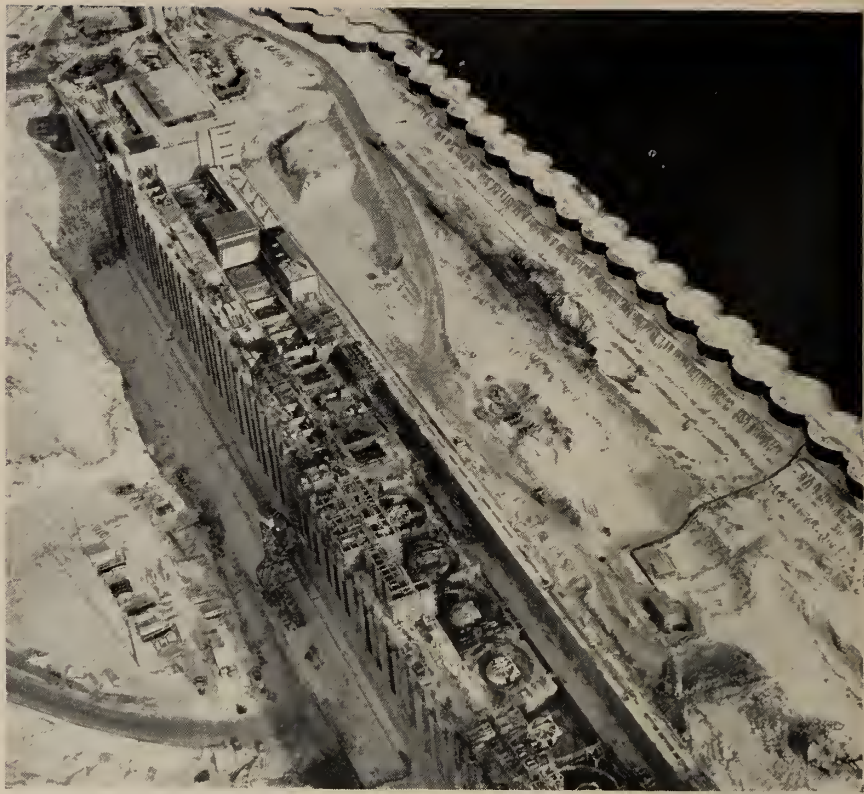
Ontario Hydro's 170,000-kw. pumping-generating station at Queenston. Three generating units are already operating.



was made that the in-service date was advanced to March 1958.

In its Cameron Falls and Alexander generating stations on the Nipigon River the Commission began installation units of 25,000 h.p. and 19,000 h.p. respectively in 1956. At the Cameron Falls station the unit will be housed in a separate structure. By the year end the work at Cameron Falls was near completion and the turbine for the unit was partially assembled. At the Alexander Falls station the turbine was installed and the generator partially assembled. Both additional units will be in service by mid-1958.

A single-unit station at Silver Falls on the Kaministikwia River is scheduled for service in September 1959. A 14 ft. lined tunnel will convey water some 9,000 feet to a powerhouse housing a 60,000 h.p. unit. Preparatory work began early in the year. By December about 1,500 feet of tunnel had been driven.



The Canadian/United States powerhouses of the St. Lawrence Power project will have a combined capacity of 1,640,000 kw., each country providing half the output. Initial service is scheduled for July 1958, and the project is to be complete in 1960.

Thermal Installations

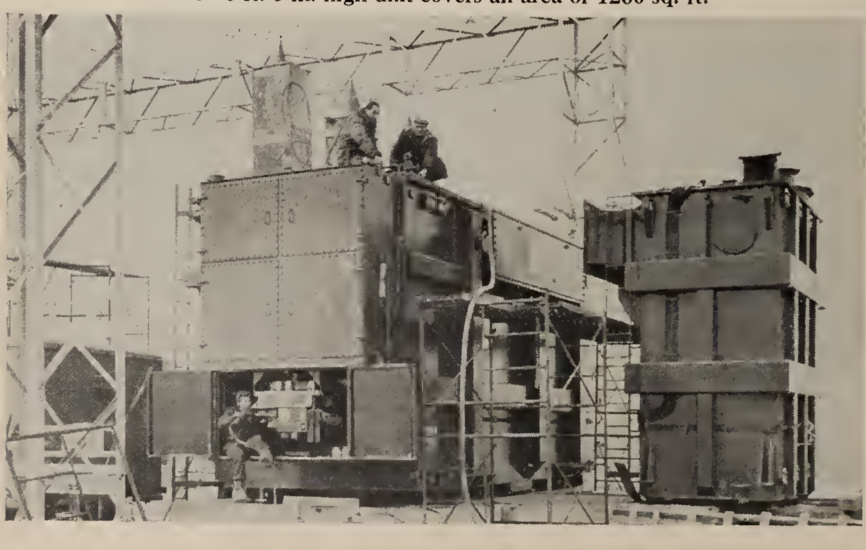
The St. Lawrence power project is the last major hydro development within economic distance of large Ontario load centres. Even in northwestern Ontario distinct advantages are to be derived from thermal-electric resources. In the fall of 1957 the Commission undertook to build three new thermal-electric stations, one at Fort William and two in the Toronto-Hamilton area.

Meanwhile work was well under way for the enlargement of the present Richard L. Hearn Station in Toronto to 1,200,000 kw., or three times its present size. Studies are being continued in conjunction with Atomic Energy of Canada Limited and other interested agencies with regard to the development of a large-scale reactor.

Apart from the activities of the Commission, the Great Lakes Power Company placed in operation in April a 30,000 h.p. unit at its Upper Falls plant on the Montreal River. Total plant capacity is now 55,300 h.p. The dam had been raised previously to a height of 86 feet, providing an average operating head of 232 feet.

The Company also is proceeding with two other hydro-electric developments; one on the Montreal River at Centre Falls where one unit of 30,300 h.p. will come into operation in April 1958, and the other on the Michipicoten River at Cat Falls having a similar turbine but with an average operating head of 100 feet, scheduled for operation in May 1959.

A 200,000-kva. transformer at Hydro-Quebec's Beauharnois power development. The 20 ft. 9 in. high unit covers an area of 1260 sq. ft.



QUEBEC

The Province of Quebec continued its extensive hydro power activities with a net capacity increase during 1957 of 473,900 h.p. after allowing for the dismantling of 10,100 h.p. of capacity. In addition, new capacity currently under construction will add about 900,000 h.p. during 1958 and more than 2,700,000 h.p. in later years.

The Quebec Hydro-Electric Commission completed the installation of the fourth and fifth units in its Bersimis I plant, some 300 miles northeast of Montreal, raising the installed capacity of the plant to 750,000 h.p. Each unit is rated at 150,000 h.p. and operates under a head of 875 feet; power is delivered to the new Bout-de-l'Ile substation on the Island of Montreal. The ultimate capacity of the underground powerhouse will be 1,200,000 h.p. in eight units.

At Bersimis II, 23 miles downstream, good progress was achieved in the preliminary stages of construction. The project involves an intake tunnel 4,000 feet long and a diversion tunnel 1,100 feet in length, the erection of two dams—one of concrete and the other of rock fill—and the construction of 60 miles of road. The powerhouse will have a total installation of 855,000 h.p. in five units, each turbine being rated at 171,000 h.p. under a head of 375 feet.

At the Beauharnois development on the St. Lawrence 30 miles from Montreal, the Commission proceeded with the third and final section of the powerhouse which will contain 11 units each of 73,700 h.p. under a head of 80 feet. Dredging operations were continued for enlargement of the intake canal. Initial operation of this section is expected late in 1958 and the completion of the entire plant, with a total installed capacity of 2,235,000 h.p., in 1960.

Among other Commission activities a storage dam on the Toulnoustouc River, a tributary of the Manicouagan, is nearing completion. This dam will allow a higher firm output from the plant of the Manicouagan Power Company, which is installing additional capacity to meet the initial power requirements of Canadian British Aluminum Company plant near Baie Comeau.

Studies and surveys are being carried out for developments in the Lachine Rapids section of the St. Lawrence River, and in the Manicouagan region on the north shore. In the field of transmission, progress was made on the construction of three additional 300 kv. lines—Labrieville to Quebec City, Labrieville to Hauterive (near Baie Comeau) and a tie line between the plants Bersimis I and Bersimis II.

The New Brunswick Electric Power Commission's hydro-electric station at Beechwood.

Price Brothers Company placed in service in September its new Murdock-Willson development at the mouth of the Shipshaw River. The plant contains one 92,000 h.p. turbine under a head of 265 feet, and is remotely controlled from the substation in the Kanogami Paper Mill three miles away. The Company's existing 10,100 h.p. Murdock plant will be abandoned.

The Manicouagan Power Company was 'on schedule' with its McCormick Dam Project No. 2, an extension of the Company's Manicouagan River plant at First Falls near Baie Comeau. The first of three additional 60,000 h.p. units, was placed in operation in December. Units Nos. 4 and 5 will be installed early in 1958. The Company's 161 kv. transmission line from the McCormick Dam to the Canadian British Aluminum smelter was placed in service in November.

Eastern Smelting and Refining Company completed and placed in operation in May its 42,000 h.p. hydro-electric plant on the Chicoutimi River. Power is supplied to the Company's nearby smelter by a one-mile 161 kv. line.

A section of the penstock and powerhouse under construction for Bowater Power Company at Corner Brook, Newfoundland. The two-million dollar project is nearly complete.

The Aluminum Company of Canada proceeded with its development on the Peribonka at Chutes des Passes, which will contain five units at 200,000 h.p. each under a head of 625 feet. The first unit will start service in the autumn of 1959. Two transmission line circuits will tie the station with the Company's present network at Isle Maligne. Work is expected to be essentially completed in 1958 on a project to divert water from Manouan Lake into the Bonard River which empties into the Peribonka.

The Shawinigan Water and Power Company made good progress on its 330,000 h.p. development on the St. Maurice River at Rapide Beaumont. The plant will comprise six 55,000 h.p. turbines under a head of 125 feet, initial operation being scheduled for November 1958, and completion of the six units in 1959.

The James Maclaren Company, which is affiliated with the Maclaren-Quebec Power Company, is building for completion in 1959, a hydro-electric station of 50,000 h.p. on the Lievre River at Dufferin Falls in Buckingham.

The Quebec Department of Hydraulic Resources, through its storage reservoirs, successfully maintained regulation of flow for power production and flood control on a number of important rivers. Extensive repairs to the Gouin Dam on the upper St. Maurice River, to Mercier Dam on the Gatineau River and to the Allard Dam on the St. Francois River at the outlet of Lake St. Francois, will be completed in the near future.

NEW BRUNSWICK

The New Brunswick Electric Power Commission placed on test, in November, the first 45,000 h.p. unit of its Beechwood development on the Saint John River, with the second unit scheduled for completion by January 1958. Provision is made for a third similar unit. Currently under construction at Saint John is a new 50,000 kw. steam plant, to be completed in July 1959.

During the year, the Commission extended its transmission and rural distribution facilities by 279 miles of line of various capacities.

NOVA SCOTIA

The Nova Scotia Power Commission completed in August its Bear River plant, in Annapolis County, with one 5,300 h.p. turbine. A 25,000 h.p. development on the Sissiboo River, in Digby County, is in active prospect and investigations are proceeding with respect to the Commission's proposed Wreck Cove development on Cape Breton Island. Under construction for completion in July 1959 is a 20,000 kw. addition to the Trenton steam plant.

The Nova Scotia Light and Power Company, at its Hemlock Falls plant on the Avon River at Windsor Forks, is installing a 5,000 h.p. unit which, late in 1958, will replace the existing two units of 1,150 h.p. each. Last February the Company dismantled its 360 h.p. plant at Chester. In active prospect is a 6,500 h.p. development on the Mictaux River at Alpena. In the thermal-electric field, the Company completed in October the addition of a 45,000 kw. unit to its Water Street plant in Halifax and is currently adding another similar unit for operation in August 1959.

The Seaboard Power Corporation is currently constructing for operation in September 1959, an additional 16,000 kw. unit to its steam plant in Sydney.

Hamilton River Falls, Labrador, where British Newfoundland Corporation Ltd. has rights to develop 4,000,000 h.p. at a single site.

NEWFOUNDLAND

Maritime Mining Corporation completed in February, on Venams Brook at Green Bay, a 460 h.p. unit operating under a head of 229 feet. In August a 760 h.p. unit, under a head of 241 feet, was installed on Snooks Arm at Green Bay.

The Bowater Power Company is continuing its hydro-electric development on the Corner Brook River where two 6,000 h.p. turbines under a head of 526 feet will start operation early in 1958. In the Grand Lake Watershed two developments are in active prospect; one of 50,000 h.p. on Hinds Brook, the other with a 14,000 h.p. unit on Little Grand Lake.

The Newfoundland Light and Power Company is constructing, for operation late in 1958, a new hydroelectric plant at Rattling Brook near Norris Arm with 17,000 h.p. in two units under a head of 307 feet. Also under construction for late 1958 operation is an additional 20,000 kw. unit at the St. John's steam plant.

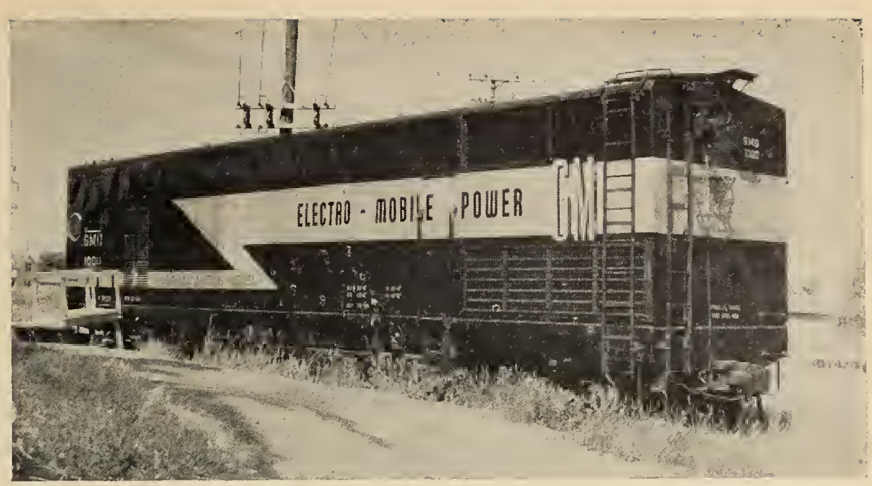
The Union Electric Light and Power Company is expanding its Trinity River Hydro-electric plant near Trinity by the addition of one 2,000 h.p. unit, under a head of 260 feet. Completion is expected in 1958.

The United Towns Electric Company Limited is adding a third unit of 3,600 h.p. capacity to its hydro-

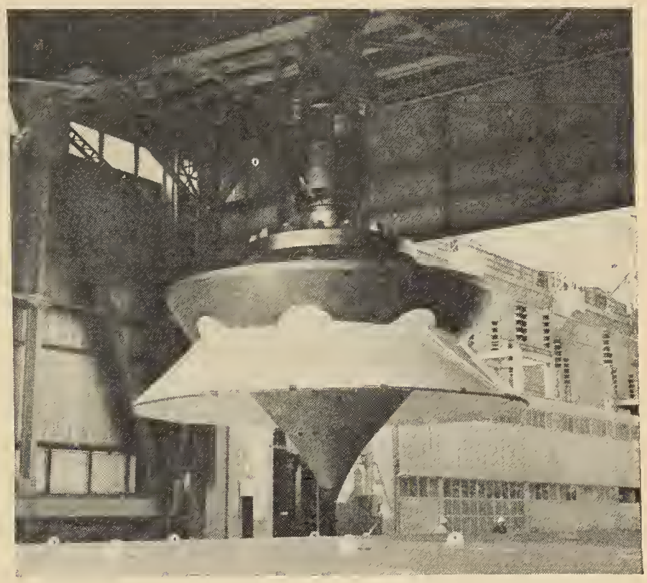
A foot-bridge over the Hamilton River and a 25-ton cable-way, under construction at the left, provide access to the 4-million h.p. Hamilton Falls project.

electric plant at Lookout Brook. The unit, when completed in 1958, will increase total installed capacity of the plant to 7,300 h.p.

The British Newfoundland Corporation is actively considering a hydro-electric development at Bay d'Espoir, where 350,000 h.p. may be developed under a head of about 530 feet. In connection with its proposed Hamilton River site in Labrador, the Corporation completed the all-weather access road from Mile 286 on the Quebec-North Shore and Labrador Railway, to the Hamilton River. The Division of Northern Labrador Affairs reports installation of three 17.5 kw. generators at Nain for public buildings serving the largely Indian and Eskimo population.



A 1000-kw. mobile Diesel-electric unit for emergency use by power utilities.



Variable - pitch blade impeller runner for the Niagara pumping - generating plant of Ontario Hydro. The six impellers will be the largest of the type built.

YUKON AND N.W. TERRITORIES

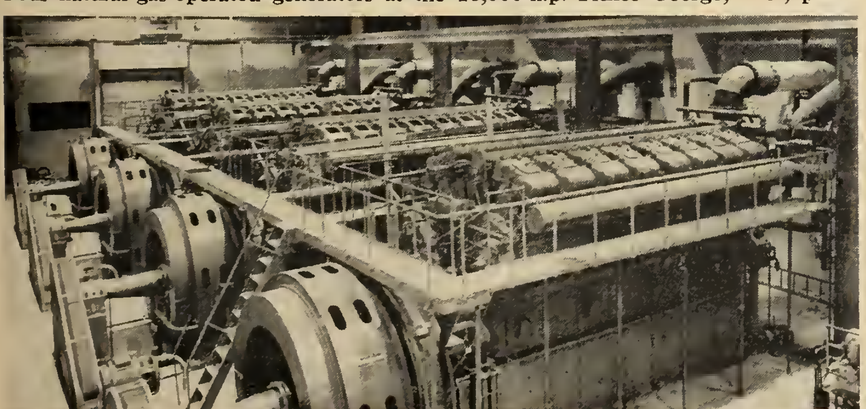
To encourage the development of resources in Northern Canada, the Federal Government established in 1948 the Northern Canada Power Commission, an agency for the construction and management of electric power utilities. Activities of the Commission during 1957 were confined to the Yukon Territory. These included the installation of a second 3,000 h.p. unit at its Mayo River hydro-electric plant, placed in operation in December; also steady progress was made on development of the Whitehorse Rapids project on the Yukon River, where the initial installation is scheduled for completion late in 1958 and will consist of two 7,500 h.p. Kaplan units under a head of 63 feet.

OUTPUT OF ENERGY

The annual D.B.S. Report on Electric Power Statistics for 1956, the latest year for which a full report has been published, shows 859 firms reporting, of which 610 were utilities and 249 were industrial establishments. The former sell most of their production while the latter generate energy for their own plants.

Of the 87.9 billion kilowatt hours generated in 1956, 68.6 billion kwh. or 78.1 per cent was generated by utilities, while 19.3 billion kwh. or 21.9 per cent was generated by industrial establishments. Of total Canadian output 92.6 per cent was provided from water power and 7.4 per cent from thermal stations.

Four natural-gas-operated generators at the 16,000-h.p. Prince George, B.C., plant.



Total ultimate customers equalled 4.43 million, of which 3.83 million were domestic and farm, 0.49 million commercial, and 0.096 million were power customers. About half a million farms in Canada were served with electricity. Average domestic and farm consumption rose 6.9 per cent from 3,500 kwh. in 1955 to 3,740 in 1956. The average annual consumption varied widely however, from a low of 1,348 kwh. in P.E.I. to a high of 5,636 in Manitoba.

Utilities only employed 36,600 persons excluding construction workers in 1956. They showed operating revenue of $789 million, expenses of $489 million, and operating income of $300 million. Net after income tax and deductions was $103 million.

Delegates to the Canadian Electrical Association meeting in June 1957 were told that firm energy requirements had stood at 82.7 billion kilowatt hours for 1956, 11.7 per cent over the previous year. The total was expected to climb to 114.4 billion by 1960, an increase in the four years of 37.6 per cent over 1956. Preliminary reports on total net generation during 1957 indicate that production, though increasing substantially in the first 9 months, had fallen sharply during the last quarter below the same period in 1957 and for the full year had reached a total of 90.25 billion kwh., up 9% over 1956.

SUPPLY AND DEMAND BY REGIONS

British Columbia, spurred by its current industrial expansion, led all provinces in power installed during 1957, with as much again under construction for completion in 1958 or 1959. The province has ample hydro resources for years to come.

Alberta is barely keeping pace with demands, which double every five years. Saskatchewan depends on thermal power and foresees half its power from nuclear sources in another 20 years. Manitoba now relies on thermal power for industrial growth in the southern areas, while developing its northern waterpowers for mining and metallurgical projects.

Ontario will have developed all its economic hydro resources by 1970. This outlook led to decision two years ago to triple the size of the H.E.P.C. thermal station at Toronto, and enlargement is now under way. Three more thermal electric stations are planned. Quebec will meet all its power needs for the next 20 years without the necessity of developing thermal power stations.

Newfoundland, with large but remote water power resources, must look to large extractive industries to develop them. Though Nova Scotia's future needs must be met with thermal plants, New Brunswick is well endowed with hydro resources. The Atlantic Provinces Economic Council has marshalled public support for its effort in awakening realization of what capital and electric power could do in expanding the Maritime economy. Adequate power for normal needs, the Council finds, are at present available. At year end Federal assistance for financing Maritime power developments was an active issue in the House of Commons.

ATOMIC ENERGY

Scientists from all over the world flocked to Chalk River in 1957 to hear what Canada was doing with nuclear energy. They learned about a new type of uranium oxide fuel assembly that had been developed for use in a power reactor. A new design for the active core of a reactor had been evolved, replacing the large pressurized vessels used in U.S. and British nuclear power plants. This design is applicable for use in stations of several hundred thousand kilowatt capacity. The N.P.D. reactor, to be built by Ontario Hydro and A.E.C.L. at Des Joachims, will be changed to this design, and construction may proceed early in 1958.

The modified design also incorporates "on-power" fuelling which has very attractive operating advantages. This change in approach has introduced some delay in the completion date, and inasmuch as NPD-2 will be more representative of the large power reactors required by utilities in future, the benefits justify the change.

Fuelling costs for some nuclear power reactors are already lower than fossil fuel costs for conventional thermo-plants. Achievement of competitive nuclear power requires substantial reduction in the present high capital costs of nuclear plants. With this in view, development work is being done which is directed towards major reductions in capital costs. For instance, the use of an organic material rather than heavy water as a reactor coolant promises great savings through lower pressures and higher temperatures, without attendant corrosion problems. Such development work may well hasten the advent of competitive nuclear power in ratings of 100,000 kilowatts and below, as well as in higher ratings.

Certainly Canada's undesirable position as the largest net importer of fossil fuel in the world would be greatly improved by the reduction of her considerable coal imports from the U.S. and the substitution of her own natural uranium fuel for electric power production. Achievement of competitive nuclear power using natural uranium will also help ensure the continued prosperity of Canada's huge uranium mining developments. The first nuclear power plants built were not expected to produce competitive power; they were built primarily to provide information and 'know-how'. These plants have performed well to date and their subsequent operation will undoubtedly provide much of the data which will allow design engineers to achieve reliability and safety at greatly reduced cost.

Operation of the N.R.U. reactor was started in November. Following preliminary tests, its power output will be raised to 200 million watts. This complicated device, which took six years to build, started operation exactly on schedule. It will provide a wide variety of new information and produce valuable radio-isotopes and plutonium. See *The Engineering Journal*, 1957, August.)

Several A.E.C.L. and Shawinigan Engineering Co. engineers are in Bombay supervising construction of the research reactor which Canada is giving to India under the Colombo Plan.

During the year the group of Canadian Utility engineers who have been at Chalk River completed a study of a full-scale uranium heavy-water nuclear power plant, based on a new conceptual design of using pressurized tubing. Once development costs on one or two large stations have been paid for, subsequent plants should be competitive with coal-fired ones such as the R. L. Hearn Station at Toronto. The recently installed pool test reactor and the beta-ray spectrometer will both enable A.E.C.L. scientists to contribute to the more efficient use of nuclear energy. The 200,000 curies of radio-isotopes shipped last year will be found useful to research, refineries, hospitals, and manufacturers.

Dam and power plant at Whitehorse, N.W.T.

Combining rail and road transport facilities is the 'piggyback' service provided by Canadian railroads. Below is the tallest of the Trans-Canada Telephone System's microwave towers (350 feet) which, at the end of 1957, linked Quebec City and the foothills of the Rockies.

TELEPHONE • TELEGRAPH
RADIO AND TELEVISION

CIVIL AVIATION
RAIL • WATER • ROAD
PIPELINES

COMMUNICATION AND TRANSPORT

RECORDS SET in 1956 by The Bell Telephone Company, Canada's largest telephone system were again topped in 1957, in capital expenditures and in local and long distance calls. Telephones installed at 190,000 were down considerably below the 288,000 added in the previous year. A total of 2,960,000 telephones were in service at the end of the year. The list of waiting customers was reduced by 8,000 and stood at 20,000 at year-end. This was indicated in year end reports of the Bell Telephone Co. of Canada, which owns some two-thirds of all telephones in operation, and accounts for 66 per cent of the employment and 70 per cent of the gross revenue received by Canada's fifteen largest telephone systems.

Industry Pattern

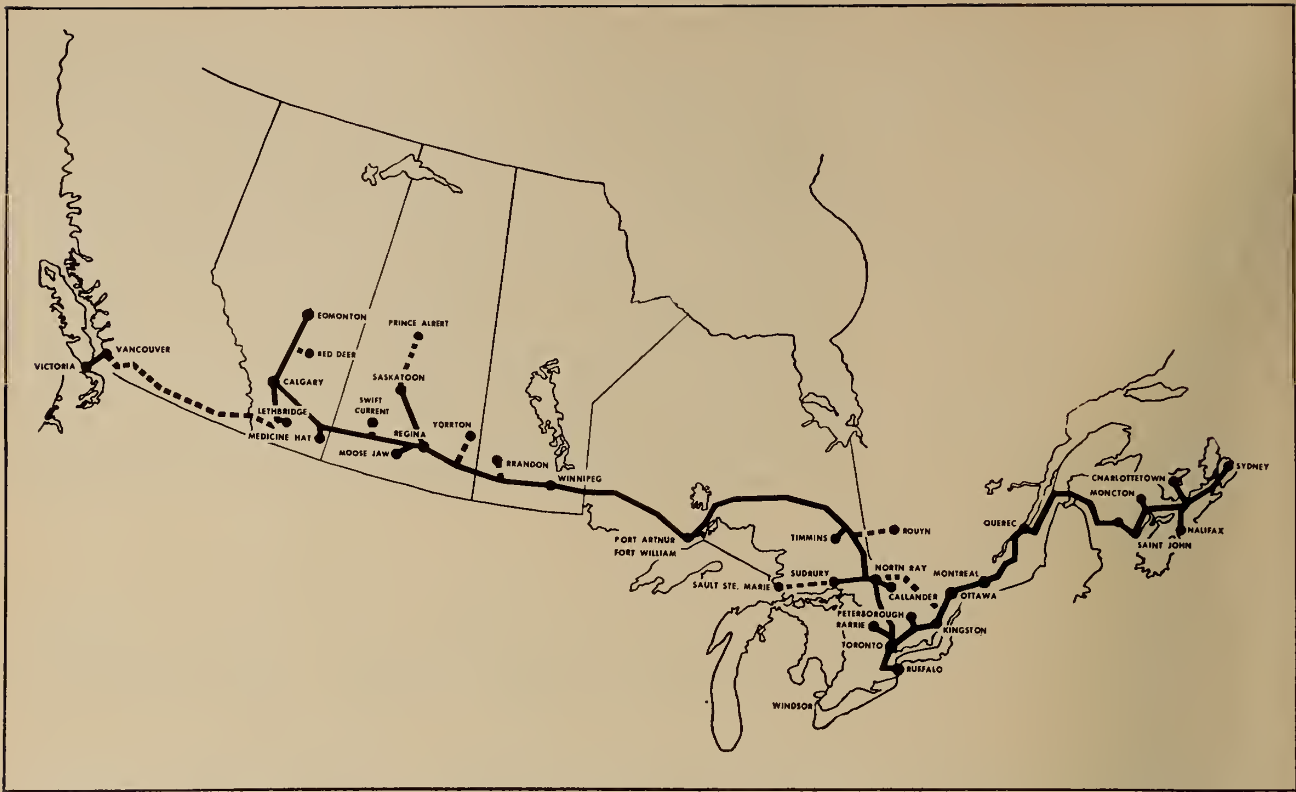
In 1956, the latest year for which full statistics of the industry are available these fifteen largest telephone systems earned 96 per cent of the telephone revenue and operated 92 per cent of the telephones in Canada. These systems operated 4,182,488 telephones, 9 per cent more than in the previous year. Cost of property and equipment at $1,609,138,000 was up 14 per cent and revenues at $397.4 million were up 12 per cent. Net income $53.5 million exceeded that earned in the previous year by 16 per cent. Employees at 58,022 increased 8 per cent and salaries and wages at $188.4 million were up 12 per cent from 1955.

Conversations, estimates of which were only available from 12 systems, increased over 1955 by nearly 13 per cent, numbering 7.44 billion or an average of 1,816 per telephone. Included in this estimate were 163,852,000 completed long distance calls, 7 per cent above the 1955 count.

Bell Telephone Progress in 1957

The use of the telephone for both local and long-distance calling in 1957 again increased substantially. Long distance calls handled showed an increase of almost 8 per cent over 1956. Introduced at Windsor for the first time in 1956, direct dialling by customers of their own long distance calls was extended to Amherstburg and in May 1958 will be introduced in Toronto. Several weeks later it will go into effect in Guelph. Within a few years this service will be steadily widened across the continent.

Acting as agent for the Trans



The telephone and television microwave network of the Trans-Canada Telephone System, including the link between Quebec City and St. John, N.B. opened in February 1958. The dotted routes indicate proposed subsequent extensions to the system.

Canada Telephone System, the Company last year completed construction of the Mid-Canada Early Warning Line. The Trans Canada system is now responsible for maintaining the larger part of the line. Together with other members of the Trans Canada telephone system, Bell is also building a 4,000 mile microwave radio relay network from Sydney to Victoria. The network is now in operation from Quebec City to Calgary, Edmonton, and Lethbridge, while the full network from coast to coast will come into service during the coming summer.

Telephone channels were added to the Toronto-Buffalo microwave link last year, while a new chain is being built between Montreal and New York. A link for T.V. and telephone was built from North Bay to Sudbury. A new dial exchange is being built at Goose Bay. In co-operation with Quebec Telephone a radio-link chain is under construction from Goose Bay to Quebec City via Knob Lake and Sept Iles. Industrial activity in the northern areas of Ontario and Quebec continues to expand, calling for extension of services.

Following approval and Royal Assent last year for permission to increase the Company's capitalization from $500 million to $1 billion, Bell applied to the Board of Transport Commissioners for permission to increase its rates, and its case was being heard at the end of the year.

Telegraph and Cable Systems

Earnings of Canadian telegraph and cable companies continued to advance in 1956, the latest full year for which records are available. A new record was established for that year at $6,784,395 — 9.7 per cent above the previous year. Operating revenues at $40.7 million were 3.6% higher than in 1955. Included in the 1956 totals, however, were results of Canadian operations of the Eastern Telephone and Telegraph Co. for the first time. Comparable figures for the remaining companies showed a 1.4% decline in net operating revenue and an increase in net earnings of only 5%.

Investment in property and equipment by eleven companies at $150 million was 20.6 per cent above that reported by 10 companies the previous year. C.N.T. and C.P.T. showed gains of $6.9 and $4.6 million respectively. Canadian Overseas Telecommunication Corp. almost doubled its investment of the previous year, with an expenditure of $13.5 million partly towards Canada's share of the new transatlantic telephone cable.

Telegrams transmitted during 1956 totalled 20,381,641; a 3.4% increase over those sent in 1955. Cablegrams transmitted at 2,429,893 were 8.6% higher than for 1955. Total pole mileage at 48,067 miles showed little change, though wire mileage at 442,891 was increased by 1%. Employment at 10,833 was decreased slightly but salaries and wages showed an increase of 3.7%.

During 1957, Canadian National Telegraphs established 47,000 miles of carrier telephone and 110,000 miles of carrier telegraph channels to meet the continuing heavy demand for private wire and other related services. Extensive facilities were provided also for government use in defence purposes. C.N.T. also placed in operation tape relay message centres at Moncton, Winnipeg and Vancouver and work was proceeding on a similar installation at Montreal for completion in 1958. These relay centres speed the service and save money in message relay handling.

'Telex' service, inaugurated jointly with Canadian Pacific Telegraphs in 1956 between Canada and overseas countries, was expanded in 1957 to provide service between many larger cities in Canada. Telex provides direct dialing and instantaneous two-way communication by teleprinter, and is receiving excellent response from business organizations.

Overseas Telecommunications

Canadian Overseas Telecommunication Corporation was established in 1950 by the Federal Department of Transport, to maintain and operate in Canada and elsewhere external communication service for the public, by cable, radio telegraph, radio telephone and other means between Canada and any other country, and between Newfoundland and other parts of Canada.

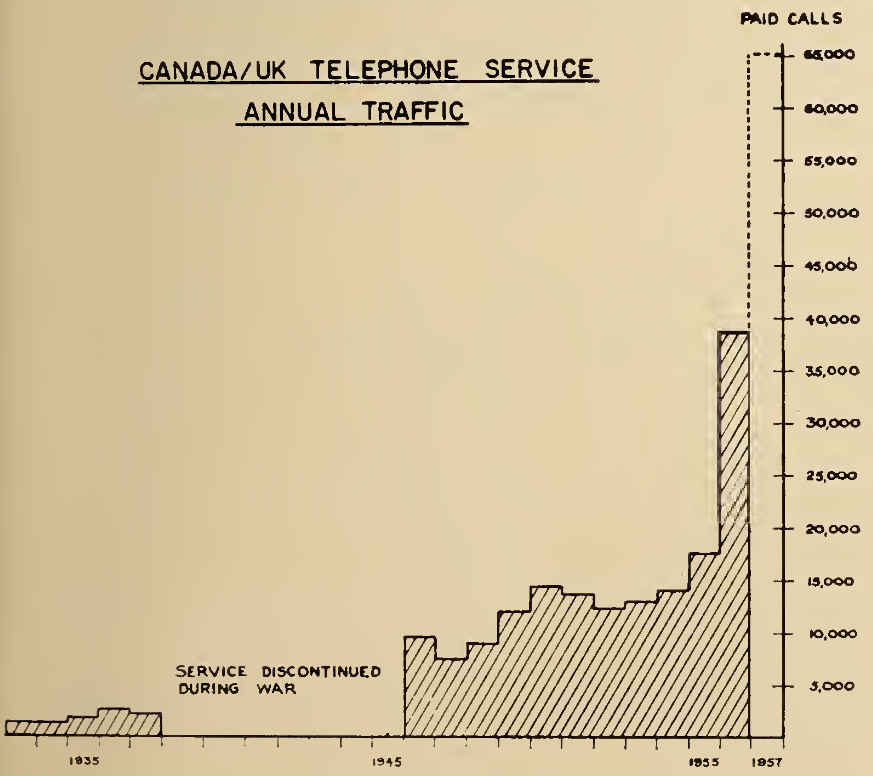
It makes use of all developments in cable and radio transmission and reception for external telecommunication service. Its objectives are improvement of service generally and the co-ordination of Canada's external services with the services of other parts of the Commonwealth. The most important project was Canada's participation in the transatlantic telephone cable, completed in August 1956, at a cost of some $40 million, of which the Corporation's share was some $4 million.

Montreal overseas Telex switchboard.

In December 1956, International Telex was brought into service. It connects teletype service through the Corporation's International Telex switchboard at Montreal, with all parts of Canada via Bell Telephone and Canadian Pacific and Canadian National Telegraphs.

At present, six cable and up to four radio channels are available for transatlantic telephone service, and have been more or less fully taken up since being placed in service in September 1956. Thirty-eight thousand paid calls were made in 1956.

The six Canadian circuits of the transatlantic telephone cable accommodate eleven FM voice frequency telegraph channels plus one pilot. Two teleprinter circuits can be provided on each. It is predicted ultimately four teleprinter circuits can be carried on each channel. International Telex service has increased by leaps and bounds. Commencing with 2 million chargeable minutes in 1947 it had risen to over 72 million chargeable minutes in 1955, and while records of growth since that time are not available there is no doubt rate of expansion has increased greatly.



Engineers predict the future holds little prospect for provision of many new high-frequency international radio circuits, but that a large number of transatlantic coaxial cables with submerged repeaters will take their place. In the telegraph communications field they believe telex will continue to grow and the public telegraph services may cease to operate as a separate system.

Canadian Broadcasting Corporation

The annual report of the C.B.C. for 1956/57, published in July last year, showed capital assets (exclusive of international facilities), less accumulated depreciation, amounting to $21.2 million. Gross income for the fiscal year 1956/57 at $49.3 million was $10.3 million higher than the previous year. Expense at $48.9 million exceeded that of the previous year by some $10 million. Excess of expense over income for the year was $1.56 million vs. $1.36 million in 1955/56. Radio services showed a profit of $202,300, while T.V. services recorded a deficit of $1.76 million.

The reports showed C.B.C. transmission facilities as follows: radio broadcast stations, 22; F.M. stations, 5; shortwave — national service frequencies, 11; low power relay sta-

Transmitting antenna used in tests over the 130 miles between Hamilton and Kinmount, Ont., in a project to develop a new communications system.

tions, 54; television stations, 8. International service was carried on eighteen frequencies with power of 50,000 watts. In addition there were a further 128 private radio stations or 'affiliates' across the nation which carry varying amounts of C.B.C. network service under various arrangements. At the end of the 1956/57 fiscal year the C.B.C. employed 5,939 persons, an increase of 917 over the previous year, mainly due to expansion and development of T.V. service.

National radio service is available to some 97 per cent of the population from all C.B.C. networks, which uses 120 of Canada's 191 radio stations plus 54 low power repeater stations as outlets. The national T.V. service at mid-1958 came within reach of some 86 per cent of Canadians through the T.V. networks, which consisted of 40 stations. Of the four million households in Canada at that time, some 2,490,000 or 62 per cent were equipped with T.V. sets, an increase of 310,000 over the previous year and almost double the number in March 1955. A further 960,000 homes without T.V. sets were within good coverage range. With completion in 1958 of the Cross Canada microwave network a considerable increase in T.V. ownership is expected in the maritime and western provinces.

CIVIL AVIATION

The spectacular 880 per cent growth in Canada's commercial air transport over a ten year period to the end of 1956 was continued throughout most of 1957. Passenger and freight traffic for the first half of the year showed increases over the same period for 1956 of 20 per cent each. During the second half, however, there was evidence of weakening demand on scheduled airlines, giving some cause for concern towards year-end.

Trans Canada Airlines

In spite of this, the full year will show increases of 16 per cent for passenger travel and 10 per cent for air freight on Trans Canada airlines, Canada's "chosen instrument". T.C.A. carries some 80 per cent of the nation's domestic air travel and 25 per cent of its air freight. Air express showed a slight gain while mail traffic continued its impressive growth.

During the year T.C.A. provided the greatest capacity in its history, 19 per cent above that of the previous year. Its fleet at year-end included 32 Viscounts and 18 other turbo-props, 11 Super Constellations, 21 DC-3's, with 13 Viscounts, 20 Vanguards, and several DC-8's on order. The T.C.A. staff numbered 9,800.

Features of the year included inauguration of non-stop transcontinental and transocean flights; new through transcontinental flights via Windsor, raising its tourist-class capacity to 30 per cent of total service offered, and approval of revisions to the Company's fare structure reducing tourist fares to 30 per cent lower than first class fares, effective on January 1, 1958.

Canadian Pacific Airlines

C.P.A., whose domestic air service in Canada is limited to routes of lower traffic density, sought authority in 1956 from the Air Transport Board to operate a competitive domestic transcontinental air service on a new main-line route pattern linking nine Canadian cities between Montreal and Vancouver.

C.P.A. service operates from Vancouver to Mexico and South America, to the South Pacific, to Japan, and via the North Pole to Amsterdam. It serves Mexico City from Montreal and Toronto. A new service to Lisbon and Madrid ex Toronto was inaugurated in May 1957, while in September the South American service was extended to Santiago, Chile.

The C.P.A. fleet at year-end included eight DC6B 'Empress' airliners, with six Bristol 'Britannia' long range turboprops scheduled for delivery in 1958. Placing of a $20 million order for six more 100-passenger Bristol 'Britannias' with a further five under option, highlighted the company's expansion programme last year. With delivery of six 'Britannias' early in 1958, C.P.A. will be the first major airline to operate this world's fastest and largest commercial airliner.

Canadian Airline Operations for 1956

In 1956, the latest year for which complete statistics are available, Canada's six scheduled airlines owned 216 aircraft of various types and leased 17 aircraft. They employed 10,980 persons, carried 2,196,000 passengers, and operated 982.7 million passenger miles and 10.87 freight ton miles. Load factor was 69.2.

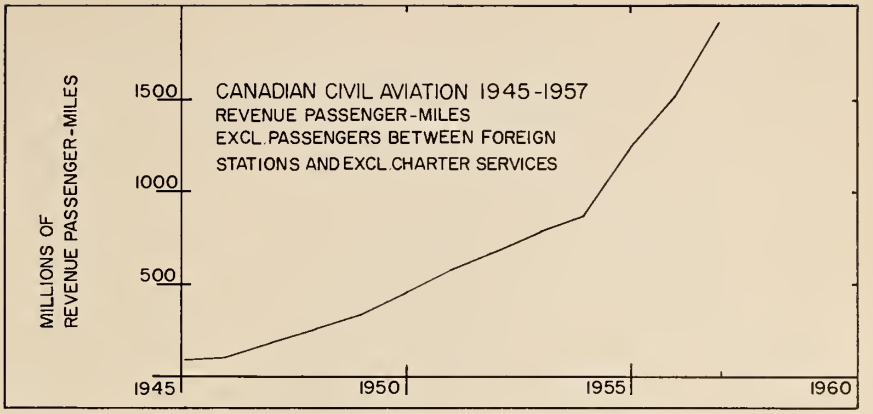
Canadian non-scheduled airlines owned 524 aircraft and leased 45. They employed 2,024 persons. Passengers carried totalled 437,750. Together they operated 4.87 million passenger miles and 237,000 million freight ton miles.

Trans-border services carried 556,600 passengers, operated 192 million passenger miles and 1.59 million freight ton miles. Atlantic and Pacific services carried 126,360 passengers and operated 359 million passenger miles and 6.59 million freight ton miles. Foreign services carried 545,000 passengers and operated 69 million passenger miles and 927 milion freight ton miles.

All the above services together owned 753 aircraft and rented 62. They employed 15,785 persons, carried 3,860,928 passengers, with a load factor of 65.1; operated 1.61 billion passenger miles and 20.2 million freight ton miles. Operating revenue at $180.5 million was 18.2% higher than in the previous year. Revenue for scheduled airlines totalled $145.4 million; revenue for 'non-scheds' totalled $35.1 million. These services transported 3,316,815 revenue passengers — 22% more than in 1955 — and flew 97.9 million miles.

For the six scheduled airlines, number of aircraft owned, millions of miles flown and operating revenue in millions of dollars respectively were as follows: Trans Canada, 66, 29.6, $91.3; Canadian Pacific Airlines, 32, 9.3, $28; Pacific Western Airlines, 53, 7.2, $10.2; Maritime Central Airlines, 25, 5.6, $10.04; Transair, 30, 2.4, $3.11; and Quebecair, 10, 1.66, $2.69.

Total operating revenue for the six scheduled airlines was $145.39 million; total operating expense was $139.73 million; net revenue $5.66 million. Operating revenue for Class B 'non-sched' carriers in domestic services was $32.74 million and expenses $29.65 million, net $2.49 million. Operating revenue for Class C 'non-sched' carriers was $2.4 million, and expenses $2.14 million, leaving net of $89,000.



Ground Facilities and Services

Airport development continued active throughout 1957. A contract for completion of the new terminal building at Dorval costing $8.5 million was awarded in December for completion in September 1959, with steel framework already completed. A $10-million airport expansion project was started at Winnipeg in June, with a building to cost $5 million. A modern terminal building was opened in May at Stephenville. Contracts were awarded in July for an international airport at Edmonton 10 miles south of the city, for completion in 1960. A 10-year $25-million expansion for Malton airport is planned.

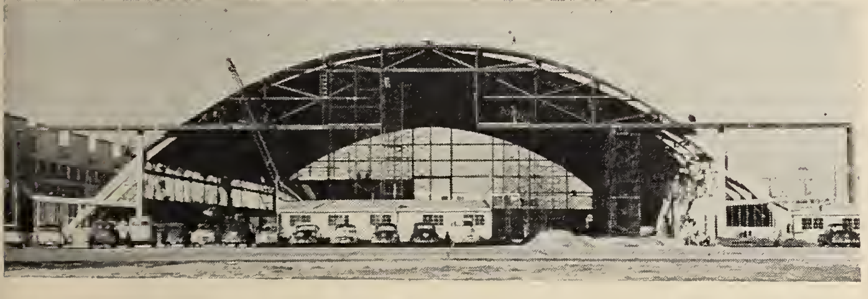
Tenders were called in December for the new Halifax International Terminal at Kelly Lake 20 miles north of the city, for completion in 1959. Tenders will be asked early in 1958 for one of the world's largest, most modern overhaul and maintenance bases at Dorval Airport. This is Trans Canada's new DC8 Jet and Vanguard turboprop headquarters, to cost $20 million. Completion is planned for late 1959. Early in 1958 the Dept. of Transport will take over from the R.C.A.F. the Tofino and Abbotsford Airports for commercial traffic, the latter becoming Vancouver's official alternate.

Medium-range radar installed last April at Dorval permits a continuous flow of aircraft and avoids stacking. Similar units followed for Toronto, Winnipeg, and Vancouver. Ultimately there will be long-range radar at all airports across Canada, with maximum range of 75 miles and up to 15,000 ft. altitude.

But, just as highway construction continues to fall behind the flood of motor vehicle production, airport authorities are being sorely taxed to keep pace with the airlines' efforts to fill the demand for better service with bigger and faster aircraft.

Trans Canada has been authorized by A.T.B. to delete Goose Bay as a point served by Class A scheduled service. The Company has applied for authority to abandon scheduled service to Kapuskasing, Ontario. Pan-American has resumed service between Gander and Shannon. Pre-inspection of U.S. Customs was commenced at Dorval in September. Last year, combined 'family' and 'fly-now-pay-later' plans were producing an astonishing volume of business for C.P.A.'s polar route to Amsterdam.

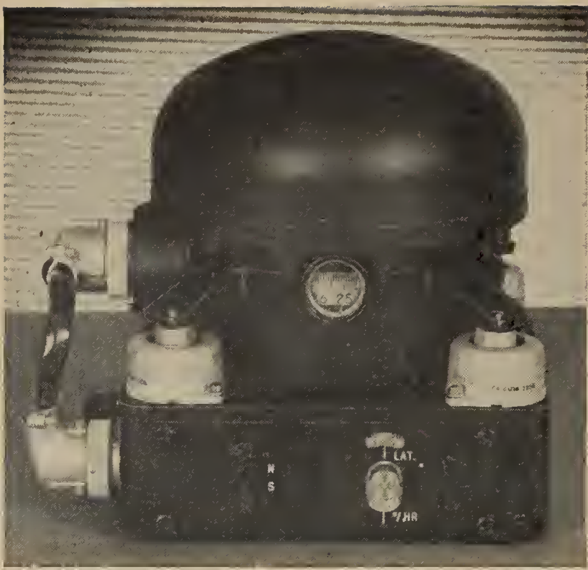
In August Nordair Ltd., successor to Mont Laurier Aviation Ltd. and Boreal Airways, inaugurated a new service from Roberval, Quebec, to Frobisher Bay in the Arctic.



The largest civil aviation hangar in Canada, shown above during construction, was recently completed at Vancouver International Airport. The unobstructed floor space will accommodate two Bristol Britannias. Another development at this airport is the first flight simulator of its kind built in Canada, to train Super DC-6B pilots. A second electronic flight trainer, for the Britannia, will be installed in 1958.

Special Flying Services

Northern operations include aerial surveys, spraying of forests for budworm control, exploration and geo-



A non-floated pattern low-drift gyro produces a random drift of less than ± 1° per hour, allowing precise navigation in polar regions where magnetic references are impossible.

logical air surveying for mineral and petroleum resources, special freight airlifts for construction and mining equipment, transport of uranium concentrates from Port Radium, rescue and mercy flights, and various charter services such as the servicing of radar personnel in the northern radar warning lines. With completion the DEW radar line early last year northern flying operations were curtailed during the winter season 1957/58, but further airlifts for missile detection equipment are expected.

RAILWAY TRANSPORT

Decreasing freight tonnage, lower carloadings, falling gross revenue, rising costs of labour and materials, disappointing net earnings in spite of some rate relief, and gains only in passenger revenue; this in brief describes what the year 1957 brought for the large majority of Canadian railroads.

Although a carryover from the previous year's heavy investment in new machinery and non-residential construction helped to maintain the economy's strength, there was a marked fall-off in residential construction. This, coupled with inventory adjustments in many industries, brought lower car-loadings for a wide range of commodity groups. Grain traffic was sharply lower, revenue freight tonnage for the first months fell some 10 per cent below the same period of 1956 and probably showed a further drop for the full year.

During the year, however, there were many indications of real progress in all phases of railroad activities. Freight and passenger services were improved, several new rail lines were brought into operation to bring rich natural resources to markets, and communications and operating techniques were modernized. Programmes for replacement of steam locomotives with diesel equipment were maintained and many 'Dayliners' placed in service. Several unprofitable passenger services were eliminated and additions made to freight-yard facilities.

Carloadings dipped 8.3 per cent to 4,037,381 from 4,402,831 in 1956 and 4,064,909 in 1955. Receipts from foreign connections were 7% below 1956; grain loadings were down 20%; grain products down 10%; coal down 10%; N. F. ores and concentrates down 9%; cement down 20%; gravel sand and stone down 15%; and L.C.L. down 9%.

Railway Statistics for 1955

In 1955, the most recent year for which statistics are published in full to date for the Canadian National and Canadian Pacific systems (which between them handle 90 per cent of the nation's rail traffic), the following figures were shown. Between them these two systems employed 207,636 persons; salaries and wages paid totalled $753.1 million; mileage of single track totalled 41,417 miles; freight traffic amounted to 72.37 billion ton miles and passenger traffic to 1.81 billion passenger miles; operating revenue amounted to $1,322.4 million. Expenses came to $1,172.9 million, leaving $149.49 million net revenue.

Equipment in Service, 1956

At the end of 1956, all Canada's railroads had 191,974 freight cars, 6,220 cars in passenger service, 90 self-propelled passenger train cars, 19,389 work cars—a total of 217,583 for all cars in service. Cars leased from other roads totalled 3,554. There were 1895 diesel-electric locomotives in service on lines in Canada, and 2849 steam locomotives.

Track mileage operated totalled 59,830 miles. First main track route mileage stood at 43,652 miles, and second track route mileage 2,476 miles. During 1956, 477,184 tons of rail costing $10.3 million were laid; 5,587,297 tons of bituminous coal, 213.4 million gallons of diesel oil, 231.2 million gallons of fuel oil, and 98,724 gallons of gasoline were consumed.

Canadian Pacific Railway

Revenues during the first 10 months of 1957 for the Canadian Pacific declined by some $13.8 million despite some traffic rate relief, freight revenues were down 11.4 million, and revenues other than from freight and passenger service were lower by $3.2 million; rail passenger receipts improved by $800,000 over 1956.

Equipment and Track

During the year, new equipment acquired included 154 diesel units, bringing to 822 the number in service. A further 122 units are on order for delivery in 1958. During the year 232 discarded steam locomotives were scrapped. Also placed in service during the year were 4825 new freight cars of all types. Twelve R.C.D. 'Dayliners' were acquired, bringing the Canadian Pacific fleet to 43 units, which have realized operating economies on low-density runs formerly served by steam trains.

During 1957, 400 miles of new rail and 250 miles of relay rail were laid on main tracks, 1.8 million ties were installed and 525 miles of track reballasted. Installation of centralized traffic control (CTC) system signalling proceeded on the Montreal-Toronto line, with control being located in Toronto. Automatic block signals were installed on the last 26 miles of the Toronto-Sudbury line and on 55 miles between Calgary and Edmonton.

"Piggyback" Started

Inauguration of common-carrier 'Piggyback' service between Montreal and Toronto took place in October, providing for the carriage of highway semi-trailers on specially equipped railway flat cars. This will result in more efficient service to users of transportation, and a considerable expansion of piggyback operation is expected.

Canadian Pacific transport continued to operate a co-ordinated rail-highway service in Western Canada, meeting with increasing success. A new head office and truck terminal were completed in 1957 in Winnipeg, and expansion of the service is continuing.

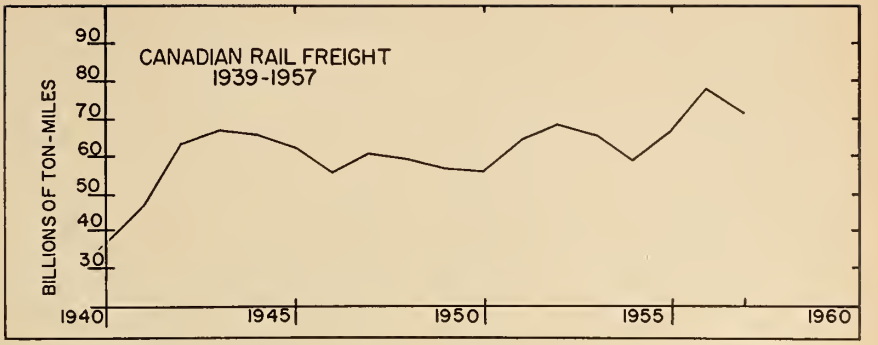
Expansion During 1957

Building projects during 1957 included modernization of passenger station facilities at Calgary, a start on a communications building at Winnipeg and enlargement of diesel servicing shops at Calgary and Montreal. Progress on the 17-storey 400-room extension to the Royal York Hotel at Toronto continued on schedule.

The outstanding development in communications services was the introduction, jointly with Canadian National, of "Telex". This new service enables subscribers to 'dial' others for direct teletype communication. Through it subscribers can communicate with 30,000 subscribers throughout the world.

Electronic Computer

Completion of the essential links in the largest system of advanced integrated data processing in Canada was achieved, with installation of the high-speed electronic computer early in the year. Under this new system information for operating, transportation, traffic, statistical, and accounting purposes is recorded on punched cards or tape at source. Information is transmitted over the company's network for processing on the high-speed electronic computer in Montreal, thence transmitted in processed form to points of use. Source recording is now in operation at 30 points with advanced equipment, and at 34 others using temporary equipment.



Canadian Pacific Steamships

The new 25,500 ton C.P.S. *Empress of England* arrived at Montreal on her maiden voyage in April. Plans were announced for construction of a third and larger White Empress. Yet un-named, this 27,500 ton vessel costing $23 million, will enter the trans-atlantic service in the spring of 1961, and will be the largest vessel of the C.P.S. fleet. It will be air-conditioned and will carry 200 first-class and 875 tourist passengers; it will be built by Vickers Armstrong Ltd. A modernization program for the *Empress of France* planned for the winter 1957-58 will provide C.P.S. with three vessels for weekly service between Britain and Canada.

Inauguration of a steamship cargo service in 1957 between Europe and Great Lakes ports reflects the Company's interest in potentialities of seaway traffic. Two small freighters made five round trips each during the 1957 season between European and Great Lakes ports.

A new diesel maintenance shop at Cote de Liesse, Montreal, for Canadian National Railways, is due to be in operation during 1958.

Canadian National Railways

Revenue freight tonnage on Canadian National Railways during the year showed a decline of 11 million tons or 11 per cent from the record tonnage of 1956. Because most of the drop occurred in low-rated commodities, and because of freight rate increases, freight revenue showed a drop of only some four per cent. If contract demands of non-operating unions costing some $77 million now pending were extended to other employees the total annual wage bill would be increased by about $100 million.

The major decreases were recorded in movement of grain, coal, ores and concentrates, some forest products, and petroleum, while main offsetting increases occurred in fuel oil, other mine products, and manufactured iron and steel articles.

Passenger revenues rose for the third consecutive year, last year by 3½ per cent, due largely to a record movement of immigrants, and to increases in fares last September of 10% for first class and 5% for coach class. In its elimination program of passenger services which resulted in large deficits, the Company discontinued train runs representing an annual saving of 290,000 train miles.

Rate increases continued to lag behind increased costs. An interim general increase of 11% in lieu of the interim 7% increase granted in 1956 was allowed in January by the Board of Transport Commissioners. A further 10% general increase was applied for in the fall. Certain competitive rates were extended to meet increasing highway competition. The Maritime Freight Rate subsidy was upped last spring from 20% to 30%. In October

'Piggyback' rates between Montreal and Toronto were put into effect.

Operations Now 70 Per Cent Diesel

New rolling stock acquired during 1957 included 6,524 freight cars, 100 passenger train units, and 152 units of work equipment. By mid-1958 all train operation on the Atlantic region, in British Columbia and on lines south of the St. Lawrence River will be dieselized. Locomotive deliveries of 144 diesel units in 1958 will make possible dieselization of the Quebec and Alberta districts.

By last September, 70 per cent of all freight traffic on the system was in diesel operation, as was 72 per cent of yard operation, and some 44 per cent of passenger train-miles. Complete dieselization of the Chicago division of Grand Trunk-Western and of the Central Vermont Railway, as well as through passenger service between Montreal and Sarnia, was accomplished during the year. Five each of new dinette and cafeteria car models were put in service on Maritime runs. New R.C.D. 'Dayliners' were placed in service on seven routes from Nova Scotia to Saskatchewan.

Buildings, Yards and Communications

New diesel maintenance shops at Montreal and Edmonton were underway and will be opened for service in 1958. Conversion of motive power shops from steam to diesel-electric repairs was commenced at Moncton, Montreal, and Battle Creek, Mich., and a similar conversion at Winnipeg is planned.

New yard facilities at Battle Creek, Flint, Pontiac, Joffre, and Sarnia will be operation in 1958. Studies on development of major classification yards were centred in Moncton, Montreal, and Winnipeg. At Montreal, grading of the site was commenced for the new hump yard, largest of its kind on the continent, a $3-million order was placed for signalling equipment. The six-year track-improvement program on the Western Region moved ahead on schedule, with widening and ballasting completed on some 300 miles. Opening of the Queen Elizabeth Hotel adjoining the C.N.R. Central Station at Montreal, scheduled for mid-April, 1958, will make Montreal one of the world's largest convention cities.

Other improvements in operating procedures included partial completion of a through teletype service for handling train manifests, car tracing teletype services, and progressive installation of C.T.C. type signalling on the transcontinental line. An advanced IBM type 650 electronic computer was installed at Montreal for computing and production of pay cheques for the entire system and for speed and efficiency of accounting and clerical operations and statistics.

New Railway Construction

The 161-mile westerly arm of the C.N.R. Chibougamau line from Beattyville to Chibougamau was officially opened in November. Grading of the first 66 miles of the easterly arm north-west from St. Felicien was nearly completed and contracts were awarded for the remainder of this arm. A second official opening marked completion by the C.N.R. of a 22-mile branch line from Bartibog to Heath Steele in New Brunswick. Both these branches will transport valuable mineral ores. A 30-mile branch from Sipiwesk on the Hudson Bay line to serve the Moak-Mystery Lake nickel project in northern Manitoba was also opened during the year.

Another $50-million 190-mile railway project will be started early in the summer of 1958 by the Cartier Railway Co., a subsidiary of Quebec Cartier Mining Co., which will open up a new iron ore area. The line, which will run from Shelter Bay on the Gulf of St. Lawrence to the Mt. Reed-Mt. Wright area of northern Quebec, will be ready for shipment of concentrates some time in 1961.

HIGHWAY FREIGHT

Unlike the railroads, which are well established and regulated by the Federal Board of Transport Commissioners, the motor trucking industry comes under jurisdiction of the various provinces. There are ten different sets of motor carrier laws and regulations, one in each province, each with major differences in policy and administration. The principal regulatory items relate to control of entry, rates, licence fees, and permissible gross weights. There is poor enforcement of regulations, even in provinces where control of entry exists. Some planning and co-ordination on a national scale is essential. One brief provincial conference on the subject since delegation of federal powers in 1954, has been held, but it proved abortive.

Since little capital is needed to enter the trucking business, many marginal operators are entering and leaving the industry each year. The large turnover makes the collection of complete and reliable statistics extremely difficult. In co-operation with provincial authorities and trucking associations, the Dominion Bureau of Statistics is steadily improving the records, though much still remains to be done.

In 1955, the latest year for which a full report has been issued, there were 912 larger carriers in the 'over $20,000 revenue' group, which together earn more than 94 per cent of the industry's total revenue, though they comprise only about a third of the firms reporting. These 912 carriers reporting operated 6,572 trucks, 7,047 road tractors, 9,330 semi-trailers, 627 full trailers and 56 buses; a total of 24,423 vehicles. An average of 22,338 employees earned $76.5 million in wages. These carriers handled 24 million tons of freight and 414,000 passengers. Total revenue amounted to $202,266,000, expenses to $192,718,000, and net to $13,548,000.

By comparison, *all* freight carriers, including those earning less than $20,000, totalled 2,681. They operated a total of 26,571 vehicles. They employed 23,518 persons. Total revenue amounted to $220,260,000, total expenses were $203,489,000, and net operating revenue was $16,536,000.

Freight carried by the smaller group, by regions or provinces, in millions of tons, was as follows: Atlantic provinces 0.27; Quebec 3.5; Ontario 9.9; Manitoba 0.6; Saskatchewan 3.2; Alberta 2.9; and B.C. 3.6. Operating revenue for the entire group of 2,681 operators in 1955 was 22 per cent higher than for 1954 and 18 per cent higher than in 1953.

Gordon Commission Report

In November 1956 the Royal Commission on Canada's Economic prospects (the Gordon Commission) issued a report on "Transportation in Canada". Thirty years ago, according to the report, freight traffic in Canada totalling 85.8 billion ton-miles was all handled by rail, water or highway. Railways carried 83.8%, another 16.1% moved by water, while only 0.1% was handled by truck. By 1945, the respective shares of these three carrier systems was 74.1%, 21.4%, and 4%. Less than 0.5% moved by air while 0.5% was handled by pipelines.

By 1953, with total traffic 25% higher at 108.7 billion ton miles, the percentage handled by railways had fallen to 60.5%, while the percentage moving by water fell to 20.1%. Motor trucks however had increased their share to 13.1% while the pipelines took 6.3%. The percentage moving by air showed little change.

The report indicated that railroads had lost considerable ground during the preceding 25 years compared with air, water, and highway transportation. Air and water carriers were the most heavily subsidized transportation agencies at some 22% each. Highway transportation received the smallest government assistance, at some 3 per cent.

Pipelines Gain, Water, Rail, and Truck Traffic Lose

By 1956, according to more recent DBS records, the total freight traffic had increased by a further 22 per cent, to some 133 billion ton miles. Of the total of some 90 billion ton miles carried by rail and truck only, motor carriers handled some 13 per cent. Of the 133 billion ton miles including water, air and pipeline transportation, however, the proportions hauled by railways and trucks had dropped; the share of water haul was slightly higher, while the proportion carried by pipeline had almost doubled.

Sample Surveys

Over the past three years the Dominion Bureau of Statistics, with co-operation of provincial authorities, has undertaken sample surveys on highway transport with a view to obtaining more complete and accurate data. To date, results of these surveys have been published for Ontario and the four western provinces, including volumes of freight carried on both highways and streets. Sample surveys in other provinces are under way. When compared with the tonnage carried in Ontario and Western provinces as shown in the full report of the industry for 1955, these sample surveys showed a greatly increased number of vehicles as well as a much larger tonnage of goods carried.

Advantages of Motor Transport

The rapid development of light industries is one of the main reasons for the growth of motor carrier operations, according to the Gordon Commission Report. Trucks are ideally suited to the movement of shipments over short and medium distances on fast, regular and flexible schedules. This type of transport can provide door to door delivery, can be more economical through lower terminal costs as well as through less rigid requirements for packing and crating.

Another basic reason for its growth is the continuous improvement in Canada's standard of living. Large increases in consumption of fresh fruits and vegetables, meat and milk products require quick delivery from farm to market to reduce spoilage. Local distribution within a 30 mile radius has represented the principal use of privately owned trucks. Companies whose operations are in different localities, each plant performing a specialized operation in manufacture of the end product can readily adjust their production and delivery requirements.

Canada's Railways Try 'Piggyback'

Most of the inter-city motor truck activity is concentrated on routes of between 20 and 600 miles. A large volume of traffic also moves on routes up to 1,500 miles in length, but beyond that point the practicability is doubtful. Development of the "piggyback" hauling of truck trailers on flatcars between Montreal and Toronto by both C.N.R. and C.P.R. systems over the past few years, has met with success, with railways hauling their own trucks.

An extension of "piggy-back" with joint use of it by railways and for-hire motor carriers, as used in the United States on a large scale, gives promise of national advantage if competitive differences of opinion could be reconciled. But there is divided opinion as to the advantages to the railways — one being that the railways earn revenue they would not otherwise obtain, the other being that any short term advantage would over the longer term be outweighed by the loss of competitive traffic.

Haulage Costs on Foods Increasing

According to a study by the Agricultural Marketing Service, U.S. Dept. of Agriculture, a year ago, the transportation bill on retail food had increased nearly fourfold since before World War II. In 1956, eight cents out of every food dollar was paid for transportation. For some commodities the hauls are growing longer as fruits and vegetables come 'in season' in various areas. The number of carlots of fruits and vegetables shipped by truck from Florida increased fourfold between 1946 and 1954. Truck rates tend to go up whenever rail rate increases are allowed. For much of transportation the rail rates are a ceiling below which trucklines want to stay. Sometimes speed is so important that truck service is used even at higher rates than those for rail movement. Similar trends are occurring in Canada.

Current Developments

- In September 1957, the Smith Transport Co. and the Canadian Pacific Railway announced jointly that the latter had an option to purchase majority stock of Smithson's Holdings Ltd., the holding company for Smith Transport and affiliated companies. The Canadian Transport Association will oppose the move. Smith Transport operates 2,000 pieces of equipment over 5,000 miles of roads. Its purchase would put the C.P.R. into operation on 8,000 miles of highway routes.

- The Department of Transport announced last June that it had authorized use of two-way radios on 'for-hire' trucks. This will substantially increase the efficiency of trucking operations.

- At the annual meeting of the Canadian Manufacturers' Association last June, President J. J. Harold of the Quebec Transportation Board pointed out highway transport had been expanding at enormous speed over the past decade. Though expansion brings many problems, he warned, the answer to these problems did not lay in trying to 'drive the trucks off the road'; as industry needed the service.

- Kingsway Transport, Ltd., a subsidiary of Canada Steamship Lines, recently opened a new transport terminal on 25 acres adjoining the Dorval airport near Montreal. It has a capacity for housing 48 trucks at a time. Buildings include a garage, warehouse, head office, and driver's headquarters. Kingsway operates a fleet of 1,150 units, owns 16 terminals along the route between Quebec City and Detroit, Mich. It also operates into New York City.

- For truck drivers, a $250 electronic device is on the market which automatically prints the date, time, mileage and gas level every time the ignition is turned on or off. It also records every time the vehicle exceeds a preset speed. And because of a shortage of trained drivers, a number of trucking companies are training their own men. A course for training the trainers, first of its kind in Canada, is planned by the Ontario Safety League.

"Fishy-Back" Trucking a Possibility

The possibility of a new combination transport service is looming, somewhat similar to the 'piggy-back' highway-rail service now in operation between Toronto and Montreal over the C.P.R. and C.N.R.: It is the 'fishy-back' service proposed by a large highway transport company, whose highway trailers would be loaded on to decks of vessels plying the seaway route.

A recent announcement stated that Kingsway Transports, Ltd., had purchased the medium-size Gossett and Sons Transport Ltd. of Calgary. Kingsway is a wholly owned subsidiary of Canada Steamship Lines Ltd., a Great Lakes and St. Lawrence shipping firm. Gossett Transport owns routes extending from Toronto to Alberta, including the Lakehead.

During the navigation season Kingsway, which operates between Quebec City, New York City and Detroit, would load on to C.S.L. vessels at Quebec, Montreal or other seaway ports for water carriage to Lakehead, while Gossett Transport would pick the trailers up at Lakehead for transport by road across the prairie provinces. The merger and expansion appears to be the nucleus of a huge transport network, with the possibility of a tie-in through B.C. via Canadian Pacific's western trucking operations which it is seeking to expand.

WATER TRANSPORT

For the year 1956, last year for which full statistics are published, Canadian water transportation companies reported a total of 2219 vessels in operation, including 1,728 owner-operated and 491 chartered. An additional 99 Canadian-owned vessels were not in operation. Of the 2,219 vessels in service, 1,043 were in the Pacific division, 692 in the Atlantic division, and 484 in the Inland division which includes the Great Lakes. Whereas 90 per cent of the vessels in the Pacific division are classed as tugs, barges and scows, only about 50 per cent in the Inland and 15 per cent in the Atlantic divisions fall into this category.

Net value of property after depreciation increased in 1956 to $157.9 million, 21% higher than in 1955. Net value rose 24% in the Atlantic division and rose 46% in the Pacific division but declined 2% in the inland division.

During the year vessels of Canadian registry carried a total of 29.3 million short tons or 32.6% of the 89.9 million tons of cargo loaded and unloaded at Canadian ports in international trade. In coastal trade, Canadian vessels carried 34.6 million tons or 89% of the total 39.1 million tons unloaded. Canadian vessels presumably handled in addition, all freight traffic on inland lakes and rivers. Total operating revenue exceeded the previous year by 23.3%, rising to $324.6 million.

A total of 21,261 employees earned wages and salaries amounting to $66.15 million. The number compared with 21,408 employees in 1955. The average wage for vessel crews rose 16.8% to $3,162, while dock and warehouse employees earned an average of $2,596 as against $2,285 the previous year.

For the first nine months of 1957, seaborne cargo both loaded and unloaded was slightly higher than for the same period of 1956, while coastwise cargo unloaded was about 8% lower. Though navigation remained open well into December the trend of loadings and unloadings continued downward for the rest of the year.

Ocean Rates Sharply Lower

Two years ago a very cold winter in the 'low countries' of Europe caused an acute shortage of coal, creating a heavy demand. Long term contracts were filled at high freight rates. Foreign trade generally was brisk. By January 1957 the rate for carrying a ton of coal from America to Europe had skyrocketed to $14.00 and, since coal is the yardstick for other dry cargoes, rates generally followed suit.

With Europe overstocked during the mild 1956/57 winter and production easing slightly, the coal rate began to soften, followed of course by rates for other commodities. The year 1957 saw cut-backs in shipments of iron ore, bauxite, titanium slag, grain, lumber and other commodities. On top of all this, there was an 8 cent per bushel higher price at Pacific ports than for the same grade of wheat at Atlantic ports. Result: no market for Canada's wheat stored at Atlantic ports; wheat cargoes hard to obtain at Vancouver. Total visible Canadian stocks of wheat of all grades stood at 369 million bushels at year's end compared with 352 million at the end of 1956.

A sharp tobogganing of dry cargo rates was inevitable. Shipbuilding had accelerated the previous fall and winter, with yards booked to capacity till 1958/59 for larger, faster vessels. The United States had been releasing 146 Liberty vessels from its mothball fleets. Even the charter hire market for vessels began to be affected, and tramp business fell considerably. By the end of 1957 the coal rate had dropped to less than $4.00 a ton and had not yet reached a levelling off point. Other rates were similarly affected. The outlook for 1958 was discouraging, and many shipowners were tying up tonnage. The Canadian National Steamships' West Indies fleet was lying, strikebound, in Halifax harbour.

More Ports but Worse Ice

New harbours are being opened up on the lower St. Lawrence. At Baie Comeau, Canadian British Aluminium Co. will unload alumina, coke, cryolite, and fluorspar, and load metal, pulp and paper. The Spar Mica Corporation has a new harbour installation at Baie Johann Beetz. Pneumatic unloaders are going in at Baie Comeau and Sept Iles, and a large grain elevator for Baie Comeau is being considered to permit a quicker turn-around for ocean tramps, and to save the 270 mile run to Montreal. Eastern sugar refiners have installed bulk discharging equipment.

Last spring the St. Lawrence and Saguenay rivers were open and remained open, while the Gulf of St. Lawrence was plugged with ice. Many vessels were caught in the ice fields and suffered great damage. Relief for this situation is claimed to be possible through building underwater dams at certain strategic points to direct the currents, but the expense would be very high.

Lake Shipping Shows Drop

In contrast to trends over the past few years, bulk cargo tonnages on the Great Lakes were lower for 1957 at most ports. During the year, 9,147 vessels passed through the Welland Canal, compared with 9,360 for 1956. Tonnage fell to 21,800,000 tons from the 1956 total of 22,200,000 tons. Iron ore shipments on the lakes were shut down in late September. Tonnage through the Cornwall Canal system was down 9% for the year. Loadings at Windsor to end of September were 12% below same period of 1956. Grain handled at Goderich was only 70% of the 1956 tonnage. Tonnage handled at Toronto was 10% lower than 1956.

Several American cities also reported lower tonnages. Cleveland predicted a 30% drop in tonnage handled below the previous year, while the New York State canal system which carries mostly bulk products was running a million tons behind. Chicago however reported higher totals with increases for ore, coal and grain.

Importers and exporters in the Great Lakes areas have been very active on studies of what effect the larger vessels coming into the lakes will mean to their business and how they can prepare for the opening of deep-draught navigation. Though no announcement had yet been made by Canada on possible legislative changes for coastal shipping, a joint decision by Canada and United States governments on the question of Seaway tolls was expected in the spring of 1958.

Maiden voyages into Montreal were made during the year by Cunard's 22,000-ton *Sylvania*, by Canadian Pacific Steamships' *Empress of England*. Other vessels appearing on the St. Lawrence run for the first time in 1956 included Saguenay Shipping's *Sunvictor*, *Roland*, *Sunpalermo*, *Sunny Girl*, and *Suminger*.

Among numerous vessels under construction were included Saguenay Shippings' *Sunhenderson* launched at Hamburg in May; N. M. Patterson & Sons Ltd. flagship *Senator of Canada*, completed in October, the 50,000-t. Imperial Oil tanker, *Imperial Quebec*, launched in August for lake and coastwise traffic, and a new dry bulk cargo carrier of about 16,000 d.w. tonnage and speed of 15 knots, now building at Quebec.

Accepted by Canadian Pacific Steamships in March 1957, the 25,500-ton *Empress of England* saw service during the year. Completely air-conditioned, the ship can carry over 1000 passengers. Double reduction geared turbines provide 30,000 s.h.p.

Shipowners' Association Asks Help

Canadian Shipowners want assistance from the Canadian government to put them on competitive terms with other countries. A Canadian merchant fleet owned and operated by Canadians, should be part of any national development policy.

In a memorandum submitted at year-end to Transport Minister George Hees, they listed the following changes as necessary to remove restrictions and tax regulations that put them at a disadvantage.

(1) An investment allowance allowing full depreciation and 40% of income tax free.

(2) Better depreciation allowance on straight line method instead of diminishing balances.

(3) Capital assistance in modernizing the Canadian fleet.

(4) Subsidy of $5 million to keep Canadian ships registered here, and Canadian-manned.

URBAN TRANSIT

Urban transit statistics for the first 11 months of 1957 indicate that, while the downtrend in passengers carried over the past 12 years was continued during the year, sharpest drops were confined to Atlantic provinces and Manitoba, other provinces showing a loss of less than three per cent compared with 1956.

For Canada as a whole, electric trams carried 11% fewer passengers, trolley buses carried 9% fewer passengers, while buses carried 4% more. Buses now carry almost 54% of the total traffic and the trend towards gas or diesel buses is growing year by year.

Gross revenue for the year showed only a moderate gain of 3% over the previous year, in which the gain over 1955 had almost reached 10%. Only two fare increases, for London and Winnipeg, were recorded.

Three years ago, at the end of 1954, 21 transit properties in Canada owned 2,128 electric trams, 1,144 trolley buses, and 2,348 buses. Today total vehicles operated include 1,447 electric cars, 1,173 trolley coaches, 4,198 buses, and for interurban and sight-seeing operations 3,504 buses.

Outstanding conversion from electric tram to bus operation was the City of Montreal's modernization program, costing $10 million in 1957. With 939 trams, 82 trolley coaches, and 522 buses in 1951, the city now operates 327 trams, 1,469 buses and 82 trolley coaches. During 1958 withdrawal of a further 185 trams and purchase of a further 345 buses is planned.

At the annual convention of the Canadian Transit Association at Winnipeg in June, W. E. P. Duncan was elected president for the year 1957/58. Predicting a 250% increase in urban population and number of automobiles by 1980, he urged a study of possible improvements in transit. President Paul Dittmar of the A.T.A., guest speaker, told members transit had either not yet learned how to merchandise the ride or transit cannot be merchandised. Transit's main efforts, he said, should be public relations, upgrading of services, and mobilization of passengers into political voting forces, for a three-legged program of social acceptance, faster service, and political support.

Transit consultant Wilbur S. Smith urged transit men to work towards a co-ordinated urban transportation system. Traffic-transit integration was one of the greatest needs for a modern city. "Some automobile transportation and some transit transportation are both needed," he pointed out. "Put the two together in the proper proportions for each city. The objective is transportation — not transit alone and not traffic alone."

Interurban and Rural Bus Lines

According to a D.B.S. report issued in September, 183 Canadian intercity carriers had reported for the first 10 months of 1957 a total of 49.6 million passengers carried, down 1.8% from the same period the previous year. Vehicle miles operated were 4% lower than for ten months in 1956. Gross revenue for the ten months at $36.2 million was up 4.8% over the revenue for the first ten months of 1956.

A new type of service appeared last year north of Edmonton, where Canadian Coachways commenced operation with the express-bus — a combination of bus and truck for northern transportation service, to take care of a sharply increased volume of express on a one-way haul. The service will be extended in 1958 as far as Fort St. John and Taylor, B.C.

PIPELINE TRANSPORT

SPECTACULAR OIL development in Western Canada over the past decade, and the success in marketing natural gas over the past two years, have resulted in a record burst of activity in building pipelines. Continuing the record set in 1956 when 776 miles of oil pipelines, 2200 miles of gas mains, and 2,970 miles of distribution lines were built, 1957 construction repeated that of the previous year in expenditure, with some 800 miles of main pipelines for oil, 2,000 main pipelines for natural gas, and 2,300 miles of laterals and distribution lines, laid during the year. The mileages laid on the various systems is shown on the accompanying Table I.

Construction methods have been streamlined in many respects with new types of equipment, especially on pipe welding where the greatest technical advances are taking place each season; unfamiliar types of terrain have taught some contractors new respect for Canadian granite and muskeg. The ability of the domestic manufacturing industry to supply pipe for Canadian projects has been vastly increased by the start-up of a number of large pipe mills. Though 1958 mileage of new main pipeline will not reach the total laid in 1957, the coming year will show great activity in building distribution systems and installing services.

Pipeline Operation

Though statistics regarding the movement of natural gas through Canadian pipelines are not yet recorded on a national basis, preparations are underway to do so by the Dominion Bureau of Statistics. Commencement of deliveries of natural gas, however, by Trans-Canada Pipelines as far as Lakehead, and the opening of Westcoast Transmission's pipeline from the Peace River to serve British Columbia communities, with export of large volumes to Pacific Coast States, no doubt increased total throughput sharply in 1957 over the previous year.

Despite the failure of the oil industry to show the usual sharp gain in annual production in 1957, net deliveries of oil by pipeline for the full year 1957 will show about an eight per cent increase over the previous year. This compares with an increase in net deliveries in 1956 over 1955 of 22.6% and an increase in net income of 51% over 1955.

Total deliveries of oil, including duplication between companies, for the first 10 months of 1957 amounted to slightly over 246 million barrels, 9.6 per cent more than for the same period in 1956. Traffic during the 10 months was divided between pipeline systems as follows, in millions of barrels: Imperial Pipeline Co., 38.7; Interprovincial, 85.2; Montreal Pipeline, 68.6; Trans Mountain, 50.9; Pembina Pipeline, 32.8; and other pipelines (including products and natural gasoline), 407.5.

Operations are being improved constantly with the use of automatic equipment on an accelerated scale, particularly in the realm of automatic custody transfer. Constant experimentation is being applied in the form of finished control mechanisms. The ultimate objective is to eliminate all purely routine manual jobs in order to upgrade every pipeline employee to a position that involves not only higher pay but more job satisfaction and more usefulness to the operating company.

Table I—Pipeline Mileage Built in 1957

System	Miles	Size in.	From	To	
OIL					
Transmountain	100	30	W. of Edson—and at Kamloops		Looping
Interprovincial	156	20	Sarnia	Port Credit	New line
Interprovincial	33	24⅛	Peebles	Kendall	Looping
Pembina	32	16	Calman	Edmonton	Looping
Westspur	75	16	Steelman	Cromer	Looping
Bellshill }	100	—	In Alberta		New lines
Rangeland }			In Alberta		New lines
Lakehead	78	26	In Minnesota		Looping
Various gathering lines	200	various	In three Prairie Provinces		New lines
GAS					
Westcoast Transmission	192	30	In British Columbia		New line
TransCanada	359	34	Regina—Winnipeg		New line
TransCanada	85	30	Winnipeg	Man.-Ont. border	New line
TransCanada	310	20/12	Toronto	Montreal	New line
N. Ont. Crown Pipeline	310	30	Man. Ont. bdry.	Lakehead	New line
Inland Nat. Gas	377	20 to 4	100 mile House—Nelson		New line
Inland Nat. Gas	498	various	100 mile House—Nelson		Laterals and Distribution
Alberta Gas Trunkline	17	34	Provost-Bindloss to Empress		New line
	100	18			
Great Plains Gas & El.	18	10	Brandon Lateral		New line

The Stratford Shakespearean Theatre, Stratford, Ont.

CONSTRUCTION

Bridge at Nine Mile Canyon on Trans Canada Highway in B.C.

THE CONSTRUCTION industry leads all other Canadian industries in the number of persons it employs and in value of production. It has recorded a new high in physical volume of work done for every year since the end of World War II, and today its potential is double that of a decade ago. Some 600,000 full time construction workers receive each year about $2¼ billion in cheques or pay envelopes, or over a third of the value of work done. They install or use new materials and equipment annually worth more than $3¼ billion. The construction program today represents 21½ per cent of the nation's gross national product, compared with 16½ per cent in 1948.

Despite the reported down-trend at year-end in rail traffic, ocean freight, and in production of petroleum, base metals, steel, lumber, motor vehicles, and several other industries, there was little recession talk at the Canadian Construction Association's Annual Meeting in January 1958. The industry may not hope for a new record volume in 1958, but they expect to do as much work as they did in 1957.

But competition has been getting keener, and industry leaders were voicing concern about unrealistic bidding, with too many failures as a result, as well as difficulties for those trying to compete. Bids, they emphasize, should not be so low as to exclude the legitimate profit needed for survival.

1957 Record to be Repeated

In a year-end forecast, C.C.A. president T. N. Carter predicted that construction volume in 1958 would be within a small percentage either way of the record 1957 level of $6.9 billion. Although there would likely be considerable swings in the various sectors of the industry, by and large the outlook for 1958 was favourable. This was due, he said, to the continued general strength of business and the sizeable carry-over of construction work from 1957. But construction figures for 1958 would be somewhat inflated by higher wage rates that in many cases had already been negotiated in long-term wage agreements. Increases in the prices of equipment and some materials were also causing concern.

Though housing completions had fallen off by some 12 per cent last year from the record number built in 1956, the program was on a large scale and the average size of units had increased. There had been an increase in the volume of 'home im-

Above. General Post Office, Winnipeg has helicopter landing area on roof of rearward 4-storey portion.

Left. Peel Centre, Montreal, is an office building completed in 1957..

Ten-storey office building in Montreal for Income Tax Division (right).

provement loans and of repairs to existing houses. 'On schedule' progress was made on the Seaway and on other large projects in the news, such as the Westcoast and Trans Canada gas pipelines and several hydro, mining, and petrochemical contracts.

Looking ahead to 1958, Mr. Carter foresaw an increase in highway construction, and a promise of larger municipal and housing construction programs.

Capital expansion for industry and commerce appeared to be dropping somewhat, and there had been a marked decrease in the number of large-scale engineering projects in the $100-million and over class. Companies active in the export market and businesses in general were taking a critical look at the price of new projects, and costs, he warned, must be kept at levels that would continue to attract investors.

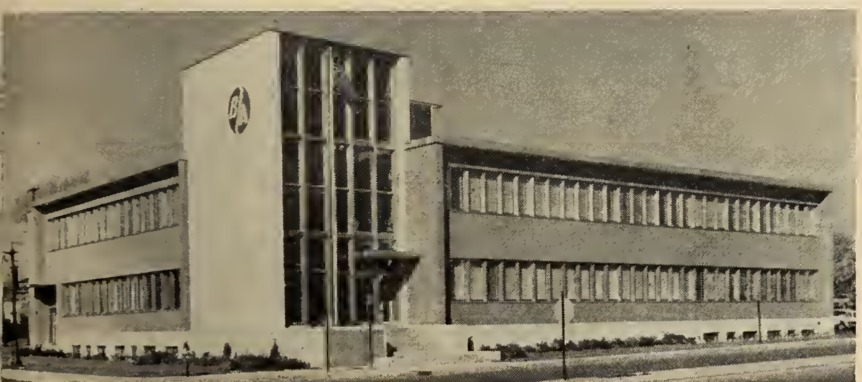
How Construction Statistics are Reported

Collection and publication of an annual report relating to the construction industry by the Dominion Bureau of Statistics, due to its size, presents many problems. At or shortly after the end of each year (e.g. 1957) a full preliminary report is published recording work done the previous year (e.g. 1956), or one year late. At the same time an estimate is given of intended construction for the following year (i.e. 1957). This estimate is based mainly on data collected at the same time and from the same sources as that used in 'Private Investments in Canada, Outlook 1957', issued earlier in the year.

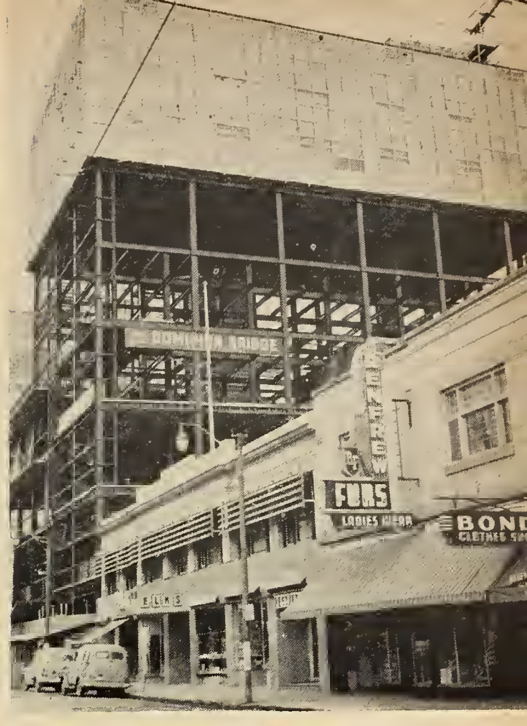
The outlook for each coming year in the construction industry, as construction men well know, is a matter of widespread interest to banks, investment houses, to contractors, and to manufacturers and suppliers of steel, lumber, cement, and other building products, as well as of machinery and equipment. The forecast of intended construction, published early each year by the Department of Trade and Commerce, is eagerly awaited. The construction industry is Canada's biggest buyer.

Another barometer carefully watched is the Hugh C. MacLean *Building Report of Contract Awards,* issued monthly. This report gives

Centre Consolidated School under construction at Lunenburg, N.S.



Office building in Town of Mount Royal has Canadian decor.



Alberta Government Telephone Bldg., Calgary.

total dollar values of awards in each province, with cumulative 'to date' figures each month compared with awards for the same period the previous year. Because some three-quarters of all construction is carried out by contract, the balance being done with day labour by utilities, manufacturers, mining and logging firms, governments and home owner-builders, this coverage is never complete.

Actually the reported contract awards usually cover somewhat less than half the construction actually carried out, for there is always a 'carry-over' of uncompleted contracts each year. Nevertheless, these monthly reports are useful in indicating the trend.

Reported 'contract awards' in 1957, for example, at $2.89 billion were 15½ per cent lower than awards during the previous year.

Industry Statistics for 1955, 1956, 1957

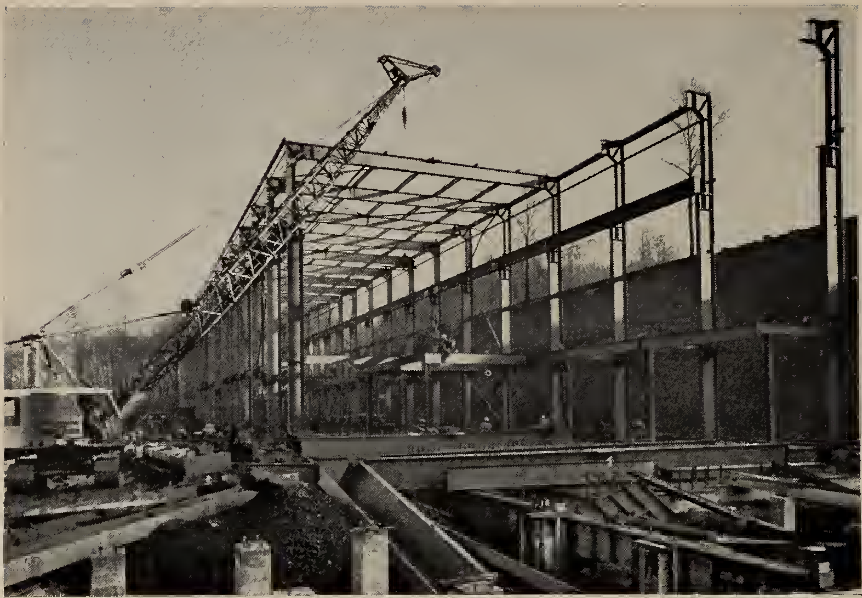
Values of construction actually performed in 1956, and of intended construction in 1957 are shown in the following tables. Table I shows the value by principal types of construction with percentages of total for each; Table II gives value by industry or sector; Table III gives value by provinces.

In total, construction in 1957 was not expected to be greatly increased over 1956, largely due to an anticipated decline of some $275 million in residential construction. Other categories, however, forecast substantial increases. Largest was expected to occur in electric power construction, with an expected rise of $166 million. Intentions for all other engineering categories showed increases for 1957 except dams and irrigation work.

Contractors continue to account for a greater proportion of construction work each year. In 1953 and 1954 they handled 72 per cent of all work. In 1955 and 1956 they handled 73 and 76 per cent respectively. This trend was apparent in both new and repair construction. Of the 605,772 workers employed in the industry in 1956, contractors employed 409,287; utilities employed 86,266; governments employed 59,590; while others employed 50,579. The trend was expected to continue in 1957.

Table I—Value of Construction Work Performed, by Principal Types of Construction, 1955-1957.

	ACTUAL 1955		ACTUAL 1956		INTENTIONS 1957	
	Value $ million	Per cent of total %	Value $ million	Per cent of total %	Value $ million	Per cent of total %
Total construction	5,311	100.0	6,389	100.0	6,702	100.0
Total building construction	3,378	63.6	3,789	59.3	3,608	53.8
Residential	1,737	32.7	1,830	28.6	1,556	23.2
Industrial	398	7.5	594	9.3	568	8.4
Commercial	514	9.7	599	9.4	688	10.3
Institutional	464	8.7	450	7.0	528	7.9
Other	265	5.0	316	5.0	268	4.0
Total Engineering	1,933	36.4	2,600	40.7	3,094	46.2
Marine construction	76	1.4	128	2.0	173	2.6
Road, highway and aerodrome construction	519	9.8	617	9.7	667	10.0
Waterworks and sewage systems	149	2.8	193	3.0	247	3.7
Dams and irrigation	39	0.7	59	0.9	57	0.8
Electric power construction	338	6.4	461	7.2	627	9.4
Railway, telephone and telegraph construction	313	5.9	389	6.1	390	5.8
Gas and oil facilities	339	6.4	533	8.3	669	10.0
Other engineering construction	160	3.0	220	3.5	264	3.9



Gas turbine thermal-electric generating plant under construction at Port Mann, B.C.

Trend to Wintertime Construction

Up to the early 'fifties' annual reports of the industry used to record the total number of workers employed by months. A comparison of the peak monthly employment in the summer with the lowest monthly employment in February or March measured the seasonal swings in employment. In pre-war years winter employment customarily fell to less than half the summer peaks, but with increased volume of construction during war years the seasonal fluctuations became smaller.

Today, with emphasis increasing by industry leaders and the Federal Department of Labour on wintertime construction, the seasonal fluctuation has dropped considerably. During 1950, last year for which monthly employment totals are available, winter employment was 69 per cent of that in the summer peak, and no doubt the trend to smaller fluctuations is continuing.

Shortage of Apprentices

The continuous rise in construction volume in the post-war years has brought about a labour shortage in many of the skilled trades, notably mechanics, plumbers, plasterers, bricklayers and painters. This has posed a problem for the industry and an earnest effort is being made to cure it. But over the past few years only about half the required apprentices were recruited yearly, and the majority were articled in the province of Quebec which has led all other provinces in the establishment of training centres.

Other industries are today overtaking construction in the drive for apprentices. Total registrations in the industry only amounted to 8,224 last year. This total was up 7 per cent over 1956 but still far below requirements. There was a definite increase in the mechanical and electrical trades but registrations in bricklaying, plastering and painting trades were almost nil.

Bell River bridge on the C.N.R. Chibougamau line, Quebec.

Highlights of the 1957 Program

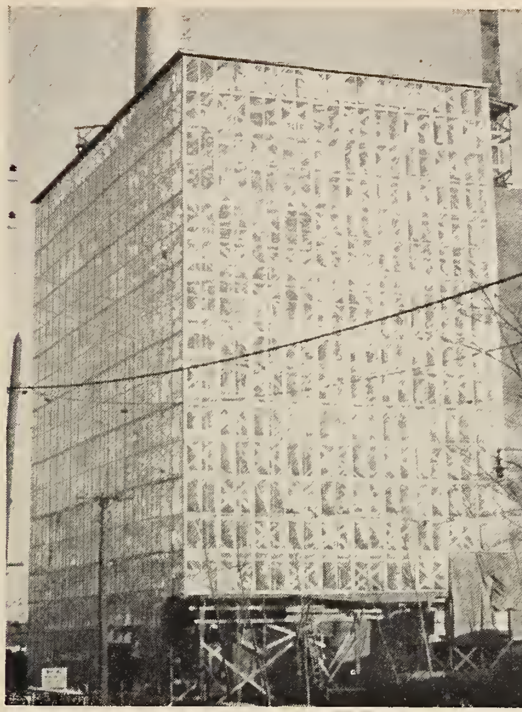
Among the many buildings and other projects which, added together, made up the $7 billion dollars worth of construction accomplished in 1956, there were many worthy of mention, but some of the highlights only can be recorded. Among them were the 650 mile natural gas pipeline from Peace River to Vancouver and Pacific States, and the Trans Canada gas pipeline from Alberta as far as Fort William, with their gathering and distribution lines; extension of the interprovincial crude oil pipeline from Sarnia to Clarkson; the DEW and Mid-Canada radar warning lines; completion of some 90 per cent of the channels and structures for the St. Lawrence Seaway and Power Project; three Canadian National branch railway lines in Quebec, New Brunswick and northern Manitoba totalling 359 miles; two of the reversed flow pumping units at Ontario Hydro's Sir Adam Beck-Niagara station No. 2, and Canadian British Aluminium's $132 million development at Baie Comeau.

Among other completions should be mentioned the Stratford Shakespeare Theatre; the reactor at McMaster University; three new furnaces for the steel industry; replacement of the seaway channel span on the Jacques Cartier Bridge; and many major highway bridges across Canada particularly in British Columbia and New Brunswick (included in expenditure of some $800 million on Canadian highways); over 100 new motels, hospitals costing a total of $136 million, as well as near-completion of the C.N.R. hotel, the "Queen Elizabeth", in Montreal, and of the 'Skyway' high level bridge at Burlington, near Hamilton, Ont.

Seaway Power

The year 1957 was the year of maximum employment on the St. Lawrence Seaway and Power Project, with the labour force on both power and navigation features peaking at some 21,000 persons in the late summer. The good progress for the year was due to good weather, a long open fall, little time lost through

Above. 60,000-kw steam power plant at Wabamun, Alberta, for Calgary Power Limited.



Builder of this Howard Smith Paper Mills Ltd. recovery furnace building at Cornwall, used method of wrapping a specially built falsework in polyethylene film as an aid to winter construction.

strikes, and an easier supply of both materials and labour in the latter half of the year.

On both the American and Canadian halves of the International Powerhouse placing of concrete had reached 95 per cent of completion, with setting of the turbine equipment well advanced and installation of generators progressing. Dikes on both sides of the river were completed. Moving of houses to new locations outside the flooded area, building of new dwellings, shopping centres, and services for them, were substantially completed.

On the American side, both the Long Sault and Iroquois dams were complete excepting for closing of sluices and cleaning up. Clearing of the park areas on both sides of the river was completed and demolition of houses will continue throughout the winter. Improvement of channels upstream from the powerhouse, a joint Canadian and American effort, though not all completed, will not retard the raising of water in the headpond next July.

Navigation Channels and Locks

At year's end S.L.S.A. president, Charles Gavsie, announced that "work on the Canadian navigation channels, locks and bridges was three quarters completed, with work progressing satisfactorily. A total of 125 contracts worth $235 million had been awarded and 29 of them were finished".

Dredging on the Canadian channels was 56 per cent completed; dry excavation was 78 per cent done, while the Iroquois lock was tested and opened for navigation in November. All concrete had been placed for the Côte St. Catherine and St. Lambert locks, while at the Upper and Lower Beauharnois locks concrete placing would be completed early in 1958. Installation of gates and machinery was under way at the Côte St. Catherine and St. Lambert locks.

Erection of lift spans over the Seaway channel was proceeding at the Victoria rail and highway bridge and erection of one temporary span over the channel on the C.P.R. rail bridge at Lachine made possible an early start on diversion of rail traffic while the new main line twin lift spans were erected over the channel. Steel erection on new highway bridge piers at the south end of Mercier bridge was started, while jacking up of the superstructure over the south half of Jacques Cartier bridge continued, following insertion of the new through-span over the Seaway channel early in October.

On the American side, with the Long Sault canal completed and all concrete placed on the Eisenhower and Grasse River locks, gate and machinery installation was under way. Dredging of three sections of the South Cornwall Channel was nearly half completed, with two further sections not started.

Little Slackening Seen for 1958

Looking ahead to 1958 and beyond, besides the substantial carryovers on seaway, highways, pipelines, micro-wave lines, gas distribution lines, steel mills, and many hydroelectric and thermo-electric power stations, there will be two nuclear reactors to build; national defence projects costing some $1½ billion plus a carryover of $54 million; hotel extensions and modernizations costing some $40 million; school construction valued at some $180 million; hospital construction costing $150 million; and motels, several millions; as well as the C.N.R. 'Place Ville Marie' development in Montreal costing $40 million.

There are several large airport projects to be awarded to accommodate scheduled air lines, and for four large jet-tanker airports in the far north, as well as another iron-ore railway in Ungava. Some sixty shopping centres are proposed for completion over the next three years costing $60 million each year. In 1958 alone it is estimated some $150 million will be spent on heating and air conditioning. Close to $900 million will be the annual outlay on highways in the future. Canada's universities are embarking on a 10-year $150/$200 million boom due to the expected 100 per cent increase in enrolments. New awards for Defence Construction will add another $100 million.

There is little likelihood of any cutback in Federal public works during 1958. Beside completions already noted, public works already awarded and under way include buildings valued at a total of some $65 million and wharves valued at $8 million.

Roads and Bridges

In the year 1957 an all time record was again established for expenditure on Canadian highways. The total outlay by ten provinces, by municipalities and by the Federal government will amount to some $861 million by the end of the fiscal year, March 31st, 1958. This is 20 per cent higher than the $722 million budgeted for fiscal year 1956. Due to higher prices, however, the increase in the physical volume of work done will be nearer to 15 per cent over 1956. The total value in 1957 represented a four-fold increase in highway expenditure over that of the first postwar year of 1946, eleven years ago.

A breakdown at various government levels reveals that provincial budgets had called for 1957 expenditures totalling $604 million—70% of the total and 24% higher than in 1956; federal budget at $71 million was 14% above 1956, while municipal budgets at $167 million were up 9% above 1956.

Per capita expenditures for highways in the various provinces during the year 1956 had shown Alberta and British Columbia leading with $51 and $50 respectively; Nova Scotia spent $47 per capita; Ontario $45; New Brunswick $43; Prince Edward Island $40; Saskatchewan $38; Manitoba $28; Newfoundland $27; and Quebec $26.

Roads Roundup

Each year at the Canadian Good Roads Association Convention a 'Roads Roundup' is held, at which provinces report their highway construction during the current year. These reports were published on page 1895 of the December 1957 issue of

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Assiniboine River bridge by Manitoba Dept. of Public Works on the Trans Canada Highway.

Overpass and underpass at Dundas and Royal York Roads, Toronto, for the Municipality of Metropolitan Toronto.

New residential area of Iroquois associated with St. Lawrence seaway project.

Mercier Bridge over the Chateauguay River, in Quebec.

C.N.R.'s Victoria bridge, Montreal, showing road traffic diversion made necessary by the seaway. Seaway construction is evident.

The Engineering Journal. Unfortunately the method of reporting by provinces varies widely and a summary of progress on miles of grading, paving, and on structures for the whole of Canada is not possible.

The Trans Canada highway at year-end was completed west of the province of Quebec except for gaps of 100 miles in B.C., some 50 miles in Manitoba, and 160 miles in Northwestern Ontario. Of the 4,470 miles of T.C.H., 1,709 had been paved at year-end and 2,435 had been graded. Only 200 miles of the total presented any driving problems. British Columbia reported heavy rock work; Alberta, Nova Scotia, and New Brunswick recorded completion of one and three major bridges respectively, while some 90 major bridge projects were under construction across the nation, most of them in Alberta, New Brunswick, and Nova Scotia.

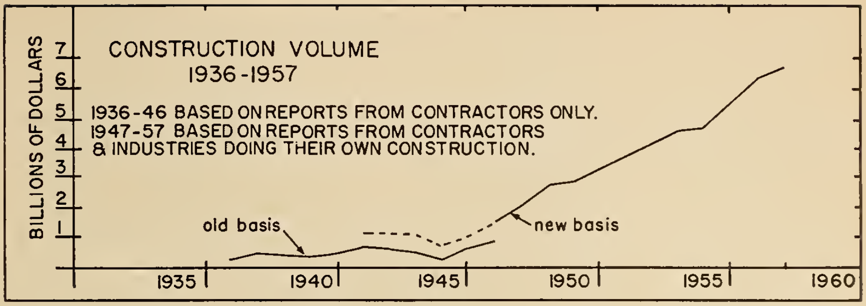
Every year since the end of World War II, while paved road mileage has been increasing steadily, the number of automobiles and trucks has been increasing even more rapidly. According to the C.G.R.A., motor vehicles travelled 38.8 billion vehicle miles in 1956, compared with 34.9 billion vehicle miles in the previous year. Ontario vehicles travelled 14.8 billion miles, Quebec vehicles did 9 billion miles of travel, while B.C. vehicles travelled 3.8 billion miles.

Thus a substantial backlog of roads still exists. However, with the reduced number of automobiles sold during 1957 and the possibility of still lower sales in 1958, as well as the likelihood of more expenditure on highways, the ratio of vehicles per mile may be in for a temporary levelling-off or down-turn.

According to the Gordon Commission Report, however, any lightening in the pressure of road traffic seems a forlorn hope. C.G.R.A.'s managing director, C. W. Gilchrist, foresees that, with the prospect of annual sales of over a million vehicles by 1975, traffic is expected to double and there is little prospect of any reversal of the steady upward trend in highway rebuilding and modernization.

Materials Outlook

Structural steel supply will be easier in 1958. Production of heavy structurals and plate increased about 20 per cent last year, while demand has levelled off. Fabricators will be able to take care of all orders with normal deliveries if large orders are placed 2 to 3 months ahead.



Though domestic lumber consumption was down last year, steady progress in both production and technology was seen in 1957 for the laminated timber construction industry. Total dollar volume was more than 53% greater than in 1956. Greatest increase was in the field of industrial building, in which laminated construction was more than three times that of 1956.

The precast concrete industry may exceed its 1957 production, valued at some $25 million, during the coming year by 25 per cent. While curtain wall panels, channel roof slabs, and bridge beams make up the 'bread-and-butter' orders for the industry, other uses are growing. Cement capacity will be adequate for demand. In the clay products industry, brick and tile manufacturers are in the midst of an expansion program for new plants and modernization of older plants, which will increase capacity.

Capital Investment Forecast, 1958/59

A forecast of capital investment for 1958-59, recently released by the Department of Trade and Commerce, predicts an expenditure of $8.5 billion, just short of the record of $8.7 billion set for 1957. Key feature of the forecast is an expected resurgence in construction activity, led by heavier outlays for housing, universities and hospitals, plus increased expenditures at all government levels. Total outlays for construction are expected to reach $5.99 billion, compared with the $5.92 billion forecast for last year. While the overall volume of capital spending may be slightly below last year, the anticipated decline will be wholly in machinery purchases, about 50 per cent of which are normally imported.

Trends

The engineer, the architect, and the constructor must all be alert to new trends in methods and materials. On 'engineering' projects, for example, drilling of rock by the jet-piercing method, erection of high concrete structures by the Swedish slip-form method, and a swing toward the use of open-air generators in hydro power construction even in cold climates, have gained popularity over the last year or two. More and more materials are being handled mechanically as labour rates continue to advance.

But it is in building construction that most of the changes appear, as twentieth century architecture replaces the last century's massive 'sculptural' appearance by the "new look" of geometric simplicity. Today's window-walled 'glass houses' are attaining wide acceptance and popularity.

Another Canadian contribution in

Table II—Values of Construction By Principal Types of Construction for Industry or Sector (in thousands of dollars).

	Actual 1956			Intentions 1957		
	Building	Engineering	Total	Building	Engineering	Total
Total	3,788,477	2,600,355	6,388,832	3,607,675	3,094,397	6,702,072
Agriculture and fishing	152,788	20,215	173,003	159,137	21,047	180,184
Forestry	11,436	47,179	58,615	10,889	42,961	53,850
Mining, quarrying and oil wells	103,218	285,417	388,635	90,686	275,939	366,625
Construction	22,565	617	23,182	17,987	1,461	19,448
Manufacturing	443,023	139,564	582,587	436,169	140,743	576,912
Utilities	111,708	1,227,189	1,338,897	120,318	1,612,388	1,732,706
Trade — wholesale and retail	198,150	15,643	213,793	246,675	20,636	267,311
Finance, insurance and real estate	98,660	13,875	112,535	123,078	13,906	136,984
Commercial services	64,294	1,766	66,060	81,132	284	81,416
Housing	1,830,400	—	1,830,400	1,555,800	—	1,555,800
Institutional services	401,411	987	402,398	462,225	878	463,103
Government departments	350,824	847,903	1,198,727	303,579	964,154	1,267,733

Adjoining Canadian and American powerhouses on the St. Lawrence River, will have a combined capacity of 1.64 million kilowatts.

the precast concrete field is the hollow floor slab for use as raceways for the installation of services. It makes for fluid floor-planning of offices, and its fire resistant qualities more than meet the most exacting demands of fire-rating boards.

The lift slab method of building construction was patented in the U.S. and over a million dollars was spent in developing it. Sets of hydraulically operated jacks mounted on the columns and synchronized manually or automatically, maintain the level of the slab to within ½ inch. It is not a new design but a new method. The whole idea was unique only in that floors and roofs are poured on the ground and then lifted in place. Formwork and shores are eliminated as well as plastered or hung ceilings. There is great economy in working on the ground.

Heating and air-conditioning systems are being inter-related more closely than ever before. Radiant heating is popular for schools and institutions. Aluminum and glass panels, electrically-heated, are gaining in popularity. Radiant cooling is still something for the future though some pilot installations have been made in city skyscrapers.

Forced hot-water installations are still the choice for most commercial and office buildings. Industrial buildings on the other hand, favor low pressure steam heating. For either steam or hot water few new products are in greater current demand than the packaged unit boiler.

A newer and more startling innovation in the heating and air conditioning field is the 'air-door'.

Floodlighting of buildings is increasing in popularity. One immediate reason has been the recent development of higher-output fluorescent lamps which operate at 13 watts per foot, giving one-third more light and using the rapid-start rather than the instant-start principle. Reflector type incandescent lamps are also coming into greater use. Outstanding examples have been the $154,000 contract for floodlighting Niagara Falls, and the floodlighting of the Parliament Buildings at Ottawa.

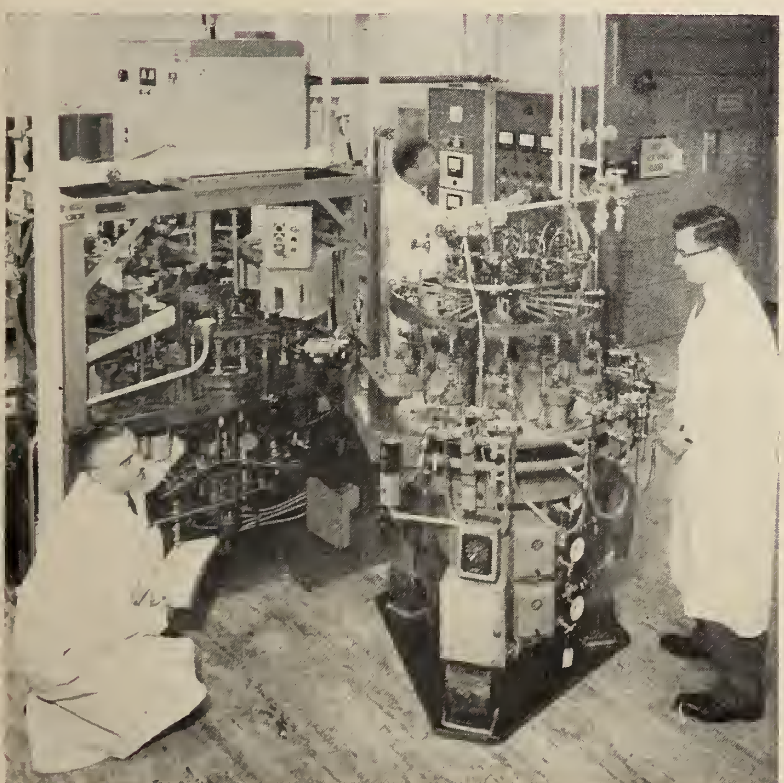
Table III—Values of Construction, 1955-56-57, by Provinces (in thousands of dollars).

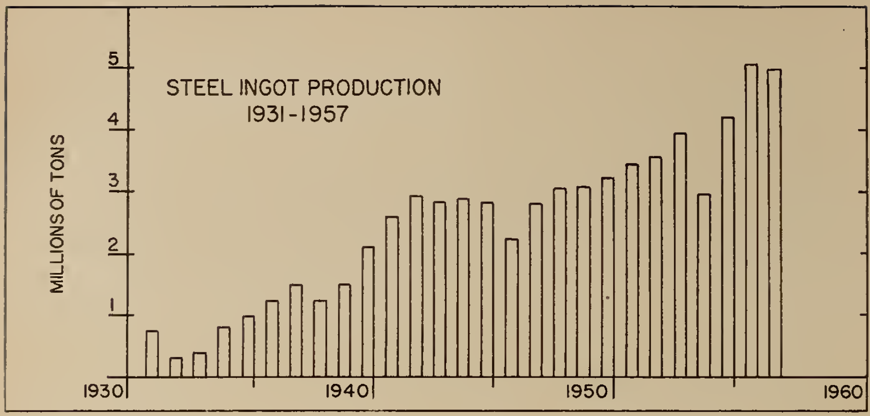
Province	Actual 1955 Building	Actual 1955 Engineering	Actual 1956 Building	Actual 1956 Engineering	Intentions 1957 Building	Intentions 1957 Engineering
British Columbia..	353,797	228,356	410,004	419,893	420,703	477,360
Alberta..........	300,476	323,129	345,697	402,019	315,305	392,532
Saskatchewan....	149,599	130,816	156,018	207,068	146,009	207,749
Manitoba........	163,664	93,769	178,832	132,073	180,948	178,359
Ontario..........	1,326,420	542,915	1,457,934	736,086	1,421,294	977,383
Quebec..........	869,073	437,520	1,021,420	508,859	894,036	676,807
New Brunswick...	84,335	69,694	82,538	84,624	85,713	73,822
Nova Scotia......	77,502	64,726	78,885	68,880	80,226	62,861
P.E.I............	9,216	7,963	7,279	9,893	8,359	8,339
Newfoundland....	43,729	33,936	49,870	30,960	55,082	39,185
CANADA......	3,377,805	1,932,824	3,788,477	2,600,355	3,607,675	3,094,397

Piers for the substructure of the new high-level bridge across the St. Lawrence between Cornwall Island and Rooseveltown, N.Y.

A contrast in industrial products is afforded by the illustrations on this page of a hydro-electric hub casting, and the sealing and exhausting of electronic tubes in a controlled atmosphere.

INDUSTRIAL PRODUCTION





IRON AND STEEL

Canada's primary steel production for the full year of 1957, at some 4.92 million tons of ingots showed a decrease of 5 per cent compared with the record level of 5.18 million tons established in 1956. Production for the year averaged 89.5% of capacity. Production of pig iron at 3.72 million tons, however, recorded a gain of 4% over the previous year. The decline in ingot output was first noticeable in the second quarter, but became more pronounced during the last quarter of 1957. At year end, however, the production rate was lower than for any year since 1954, with operation at 80% of capacity.

The Steel Company of Canada is the leading producer in the industry, with some 40% of total ingot capacity. Algoma is in second place with about 19.3% of capacity, followed by Dominion Iron and Steel, The Dominion Foundries and Steel group, and Atlas Steels, in that order.

Although Canadian ingot capacity has expanded rapidly over the past four years, little further capacity was added during 1957. However, Algoma continued with the installation of oxygen steel-making equipment similar to that of Dofasco, where continuing success of its process is of wide interest to steel-makers. Dosco added a 250-ton tilting open-hearth furnace. Dominion Foundries and Steel added two new blast furnaces. Stelco added a new blooming mill, while Atlas Steels continued on its $12 million expansion plan with an expenditure of some $4 million on buildings.

In recent years Canada's primary iron and steel industry has expanded more rapidly than that of any other major nation. Sixteen blast furnaces at the end of 1956 had a combined rated annual capacity of 4.22 million tons of pig iron. Steel furnace capacity was rated at 5.81 million tons, five per cent over the capacity at the end of the previous year. Of the 124 furnaces, 82 were electric furnaces whose combined capacity was 16½% of the total. Ingot capacity of 5.47 million tons was 88% from basic open hearth furnaces (including oxygen vessels) while the remaining 12% was from electric furnaces. Capacity for steel castings was 343,150 tons.

The Industry in 1956

In 1956, the last year for which full statistics are available, 48 firms were included in the industry and reports came from 63 plants or departments including 5 blast furnace departments, 4 ferro-alloy plants, 38 steel furnace divisions, and 16 rolling or drawing mills. The industry employed a total of 36,043 persons, divided as follows: 25,654 in Ontario; 4,366 in Nova Scotia; 4,273 in Quebec; and 1,750 in Manitoba, Alberta, and British Columbia. Total salaries and wages amounted to $162.9 million. Materials used in processes cost $301.3 million.

Factory sales of pig iron, ferroalloys, ingots and castings at $680.9 million were 29.4% higher than 1955. Eighteen plants in Ontario accounted for 78.1% of the total, fifteen plants in Quebec accounted for 10.6%, three plants in Nova Scotia accounted for 7.5%, while the remaining 3.8% was accounted for by 14 plants in Manitoba, Alberta and B.C.

Pig Iron

Output of 3,568,200 net tons of pig iron in 1956 was 11% higher than in the previous year. Production of basic iron amounted to 2.99 million tons or 83.8% of the total, while foundry iron amounted to 150,354 tons and malleable iron to 427,627 tons. Producers sales of pig iron totalled 649,213 tons. Charges to iron blast furnaces included 4.67 million tons of crude iron ore, 1.85 million tons of beneficiated iron ore, 3.05 million tons of coke, and 1.09 million tons of limestone. Imports of pig iron totalled 12,637 tons and exports totalled 257,627 tons. Apparent consumption in Canada amounted to 3.35 million tons.

Ferro-Alloys

Ferro-alloys were produced by 10 establishments, 5 of which recovered ferrosilicon as a by-product. Output for the year at 240,480 tons was 26.7% higher than in 1955. Altogether ferrosilicon was made in nine plants, ferrochrome cilicon in two, ferromanganese in one, silicomanganese in one, speigeleisen in two, and ferrophosphorus in one.

Steel Ingots and Castings

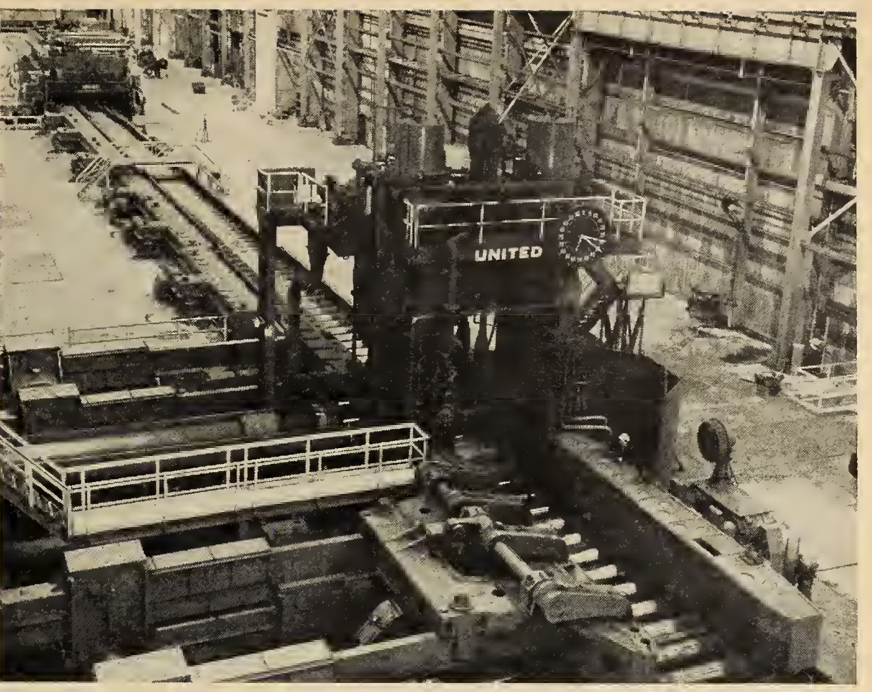
Steel production in 1956 at 5.3 million tons was 169% higher than in 1955. Of the total, steel ingots amounted to 5.18 million tons and castings to 120,781 tons worth $55.33 million. The thirty-eight steel plants in operation used 2.9 million net tons

This ore bridge has a capacity of 17 tons and can unload ore and coal boats at a rate of 1200 tons an hour.

of pig iron, 2.86 million tons of scrap iron or steel, 472,476 tons of iron ore, 232,065 tons of limestone, 202,352 tons of dolomite, 147,911 tons of lime, 138,763 tons of silica sand, 10,784 tons of magnesite, and 67,123 tons of ferro alloys.

Rolled or Drawn Steel

There were 13 mills occupied chiefly in hot-rolling of steel products and 3 mills making only cold-drawn or cold-rolled shapes. Nine mills were in Ontario, two in Nova Scotia, two in Quebec and one each in Manitoba, Alberta, and B.C. Rolling mill sales at $545.5 million were 30% higher than in 1955. Values of main items sold during the year were: hot-rolled bars, $112.3 million; plates, $36.9 million; rails and fastenings, $45.6 million; blooms, billets, etc., $20.6 million; structural shapes, $36.4 million; wire rods, $42.6 million; cold-rolled strip, $14 million; skelp, $35.3 million; and other rolled products, $177.9 million.



The new bloom mill at the Steel Company of Canada plant in Hamilton was nearing completion at the end of 1957. During the year, ore dock facilities were extended, a new pumphouse, continuous pickle line, and roll shop were completed, and other major works were in progress.

Mostly Domestic Market—Exports Small

Canada's steel production is geared almost wholly to the domestic market. Export of primary steel or steel products comprise a small proportion of total output. Most manufacturing industries and many of the primary and service industries are buyers of steel.

Large tonnages of steel are used in production of consumer durables — stoves, refrigerators, automobiles, and the like. An extensive variety and quantity of steel goes into capital goods — buildings, bridges, housing, factory buildings. When these industries are busy the steel industry is also busy. Any important reduction in the operations of these consumers is immediately reflected in steel output.

Consumption of Carbon and Alloy Steel

End disposal during 1956 of carbon and alloy steel products to various destinations and industries, in thousands of net tons and in order of importance, was as follows: building construction, 680; pipes and tubes, 464; railway operation, 404; merchant trade, 382; wholesalers and warehouses, 363; containers, 298; machinery and tools, 229; exports, 212; automotive industry, 199; railway rolling stock, 187; pressing, forming and stamping, 164; mining and lumbering, 92; agricultural, 78; public works and utilities, 40; shipbuilding, 34; miscellaneous, 7; and national defence, 5.

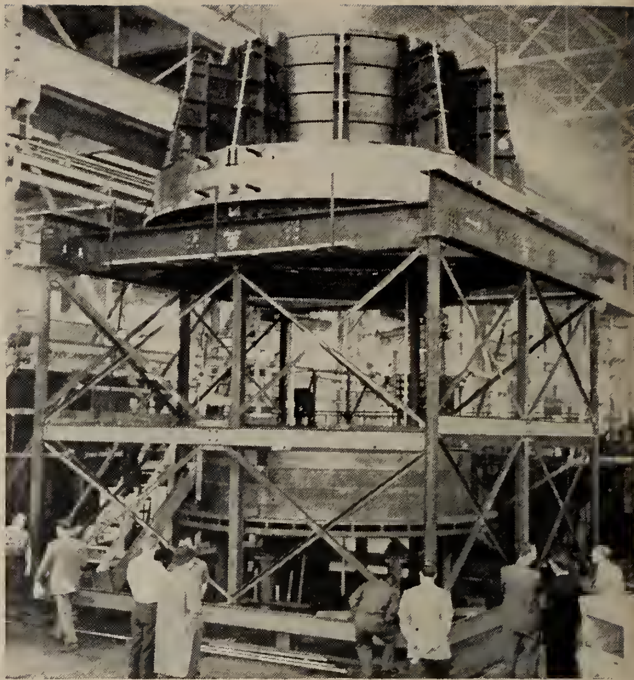
Preparing to complete a pour of 200,000 pounds of steel for a large casting.

The Threat of Foreign Competition

World steel capacity has been growing steadily since World War II. Damaged plants in Europe, the U.K., and Japan have been replaced with the most modern equipment. Low wage rates enable steel producers outside America to manufacture products at costs well below Canada's. The advantage that Canada once had in terms of up-to-date plants has largely disappeared. Nor have governments seen fit to bring up to date the provisions of Canadian customs tariffs, designed half a century ago at a time when steel capacity was less than 15 per cent of the present level.

Today the Canadian steel industry is equipped to produce most of Canada's steel needs. Heavy structural beams and other steel products, now imported, could be made in Canada if adequate and equitable tariff protection were provided. The Canadian market is customarily invaded by British and European producers at times when their own markets are soft. When shortages develop in their home markets or when higher prices are available elsewhere, the competition vanishes, leaving Canadian mills to cope with increased demand.

World oversupply of steel products today makes Canada most vulnerable to active and low-priced competition from overseas, that cannot be met if we are to maintain our standard of living and a high degree of employment.



The steel fabricating industry has a new customer in the nuclear power field. Here are pile core components of the Canada-India reactor.

Steel's Future As Seen by Ontario Research Foundation

The most striking development in the past three years was not in the field of iron and steel production, according to Director P. E. Cavanagh of the Ontario Research Foundation. It came in the field of discovery, promotion and development of iron ore deposits. The use of new exploration techniques, combined with the proof that low grade deposits can be worked to produce a profitable marketable product, more attractive as blast furnace feed than average direct-shipping American ore, has had a great impact on Canada's future as an iron-ore producing nation.

Much research and development now going on will develop processes suitable for partially processing ore into metallic melting stock before it is exported. The availabilty of reasonably priced natural gas in Northern Ontario and British Columbia can radically change the economics of iron mining and processing. Work is proceeding rapidly on special processes to take advantage of the combination of natural gas and concentrated iron ore for turning an uneconomic deposit into a profitable operation.

Production of steel melting stock from rich concentrates and natural gas is one of the most interesting possibilities. It offers the chances of operating on a small but profitable scale (marketing a $60 product in place of a $15 product) and it eliminates the need of very high concentrates for sale on the open market to blast furnace operators, when slightly lower grades might be smelted profitably at the mine into melting stock, he observed.

Under Canadian conditions and for certain types of steel products the installation of the oxygen process is more profitable than installation of the standard open hearth for making steel. Commercial use of continuous casting and a hot planetary rolling mill to make specialty steels at Atlas is demonstrating the profitable fields for the combined application of these methods for the first time.

A 123½-ft. process tower for the chemical industry—a large platework product.

Trends in Investment and in Consumption

In most postwar years, the rate of growth of investment in steel has far outstripped the rate of investment in total manufacturing facilities. The Canadian primary iron and steel industry in the ten years 1948-1957 spent some $411 million on new plant and equipment. Of equal significance was the contrast in percentage of profits retained for expansion —41% for steel, 31% for all corporations, as against the percentage paid out for dividends, 16% for steel, 24% for all corporations.

Compared with the 'thirties' Canada made a greater advance than any other important country in *per capita* steel consumption by the early 'fifties', and ranked second to United States among all nations in the world. But by 1955 our *per capita* consumption had fallen off a little, while it was increasing in nearly every other country. The U.K., West Germany, Sweden and Australia had all moved ahead of Canada.

Is Steel Industry Too Cautious in Expanding?

A study of the future for the steel industry of Canada, prepared for the Gordon Commission on Canada's Economic Prospects, estimates that by 1980 Canada's annual steel consumption will be between 14 and 16 million tons, a 300% increase over the present rate. Production will be between 12 and 14 million tons, against a little over three million in the early 'fifties'—a 200% increase.

The cost of additional facilities needed might reach $2 billion with present processes, but new processes, such as oxygen sponge iron and continuous castings may well cut this cost per ton of capacity quite sharply —perhaps 50% in some cases. Growth of this sort is needed if Canada is to maintain the expansion and prosperity achieved in the past decade, for steel remains the foundation of an industrial economy.

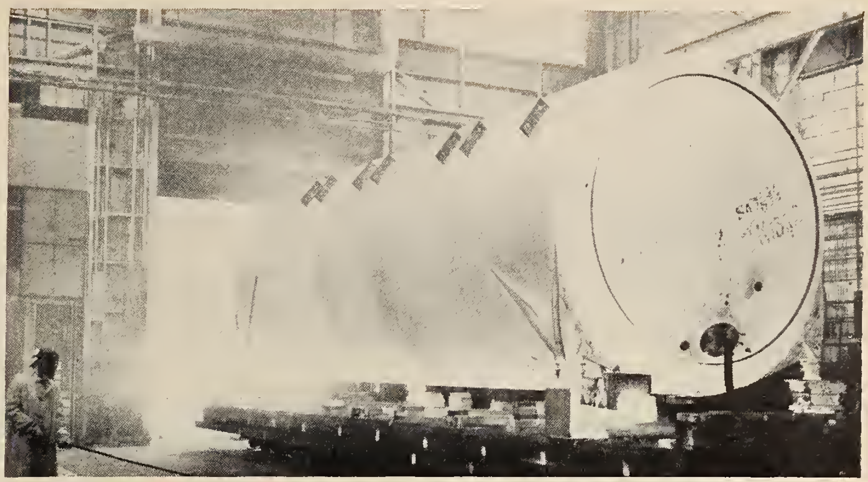
IRON CASTINGS

Production of iron castings, pipes and fittings in 1957 at 743,716 tons was 17% lower than production for the previous year. Shipments at 583,420 tons were 10½% lower than in the previous year. The biggest decrease occurred in cast iron water pipe and fittings, which showed a drop of some 29%. This drop was due to curtailment of municipal expansion plans because of tight credit. Pig iron used at 298,173 tons and scrap at some 600,000 tons were both some 16½% lower than in the previous year.

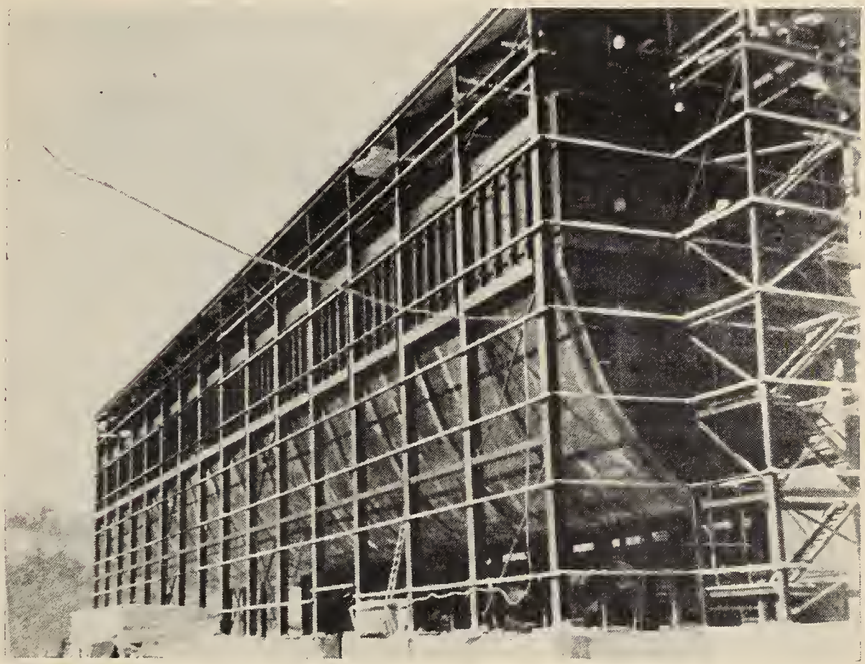
The industry covers operations of iron and steel works which were chiefly occupied in making commercial iron castings or iron and steel pipe and tubing. Some machinery boilers, engines, stoves and furnaces, etc., were made as secondary or minor products. Some iron foundries have not been included in the Iron Castings Industry, but are classified to other special groups such as manufacturers of agricultural implements, stoves, etc.

The year 1957 was marked by a continued rise in production and shipments of alloyed irons. Production of ductile iron rose 61% and production of 'Ni-hard' increased 38% in the first half of the year. For cast iron pipe a new type of slip-on joint was introduced, using a rubber sealing ring instead of bolts and glands, permitting faster assembly while preserving the water tightness.

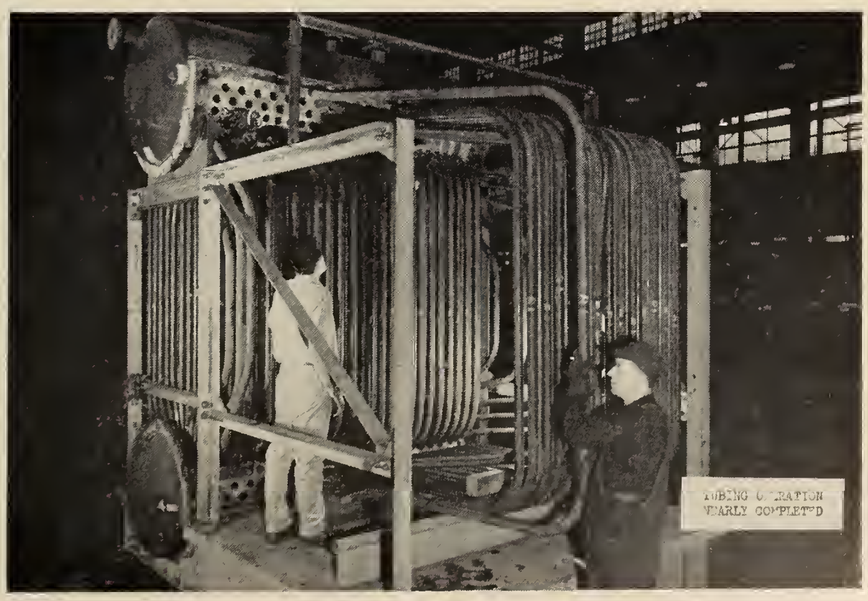
During the year Canada's first water-cooled hot-blast cupola was



A 40-ft. long glass-lined steel storage tank leaving the firing furnace.



Above: 1000 tons of steel were used to make this 15,000-ton capacity ore bin. Below, assembling tubes for a 9,000-lb/hr. package water tube boiler unit.



installed at Toronto, among the early few of such installations on the continent. The first fully automatic crane-type charging unit in Canada was put into operation in Quebec City, while a new modern cast iron water pipe plant was completed in Calgary.

The Industry in 1955

Last full report of the iron castings industry published was for the year 1955, when 201 establishments employed 15,266 persons, who earned $55.27 million (9,831 of these workers were employed in Ontario and 3,664 in Quebec). Cost of materials was $84.45 million, and gross selling value of products totalled $182.9 million.

A special study of all reports in 1955 showed some 400 operating foundries in Canada, which used 345,000 net tons of pig iron, 627,000 tons of scrap iron and 136,000 tons of cupola coke. Production of iron castings totalled 849,000 tons.

BOILERS AND PLATE WORK

Judging from preliminary reports for the first nine months of 1957, value of shipments in 1957 by the boiler and plate-work industry at some $145 million was up about 16 per cent over the value of some $124.6 million shown for the previous year.

The boiler and plate-work industry covers the operations of establishments that make as their chief products such articles as heating and power boilers, heating radiators, tanks and miscellaneous products from steel plate such as bins, hoppers, smoke-stacks, etc.

In 1955, latest year for which a complete report is available, there were 101 establishments in this industry employing 8,378 persons. Ontario employment by 51 plants totalled 5,473; 21 plants in Quebec and Nova Scotia employed 2,093; British Columbia's 15 plants employed 436; while the three prairie provinces' 14 plants employed 376 between them. Total salaries and wages amounted to $31.2 million, materials cost $41.39 million, value added by manufacture was $51.8 million, and gross selling value of products was $93.48 million.

Value of production in 1955 by categories was made up roughly as follows; heating boilers, $5 million; power boilers and parts, $9.5 million; radiators, $3.4 million; fabricated plate and structural shapes $14 million; miscellaneous plate work, $4 million; tanks, $16 million; and all other production $41 million.

STRUCTURAL STEEL

Based on preliminary reports during the first three quarters of 1957, shipments from the bridge building and structural steel industry were valued at some $152 million, compared with a value of $199.5 million in 1956, a drop of some 24 per cent. Shipments were only about 2 per cent below the total for 1955.

This industry includes all firms occupied chiefly in fabricating and erecting steel for bridges, buildings, etc. During 1955, the most recent year for which complete statistics are available, it covered the operations of 49 plants of which 25 were in Ontario, 13 in Quebec, 4 in British Columbia, 4 in Alberta, 2 in Manitoba, and 1 in Nova Scotia. Employment of 11,863 persons was divided as follows: Ontario, 4,711; Quebec, 3,964; B.C., 1,342; Nova Scotia and Manitoba, 1,156; and Alberta, 690. Salaries and wages totalled $46.6 million, cost of materials totalled $79.7 million, value added by manufacture was $76.4 million and gross selling value of products amounted to $157.7 million.

Tonnages of steel delivered during 1955 were as follows; for buildings, 285,600; bridges, 31,276; transmission towers, 14,693; other structural work, 29,174 — a total of 360,741 tons valued at $110 million. Other production valued at $89.3 million included plate and tank work, cranes, trolleys, boilers, machinery, unfabricated channels, etc., custom work and repairs, barges, reinforcing steel and castings.

A 46-ton 92-ft. long atmospheric column for a new petroleum refinery.

SHEET METAL PRODUCTS

Based on preliminary reports for the first three quarters of 1957, value of shipments in that year from the sheet metal products industry at some $285 million was about 2% higher than the value of shipments in 1956 of $278.6 million.

The industry chiefly manufactures articles from steel sheets, tinplate or galvanized plate. Main products are tin cans, galvanized sheets, metal bottle caps, sheet metal building materials, enamelled kitchen ware, culverts, galvanized ware, steel barrels and drums, eavestrough, stove pipe, etc. Many sheet metal shops doing contract and repair work, but not making a regular line of goods for sale, are not included.

During 1955, most recent year for which a full report was published, there were 360 establishments employing 19,080 persons, whose earnings totalled $66.6 million. Ontario plants numbering 189 accounted for 11,300 workers, while Quebec's 88 plants employed 5,013 workers. Thirty-one plants in British Columbia and the Yukon employed 967 persons; Alberta with 13 plants employed 474; Saskatchewan employed 256; New Brunswick 99; and Nova Scotia 67.

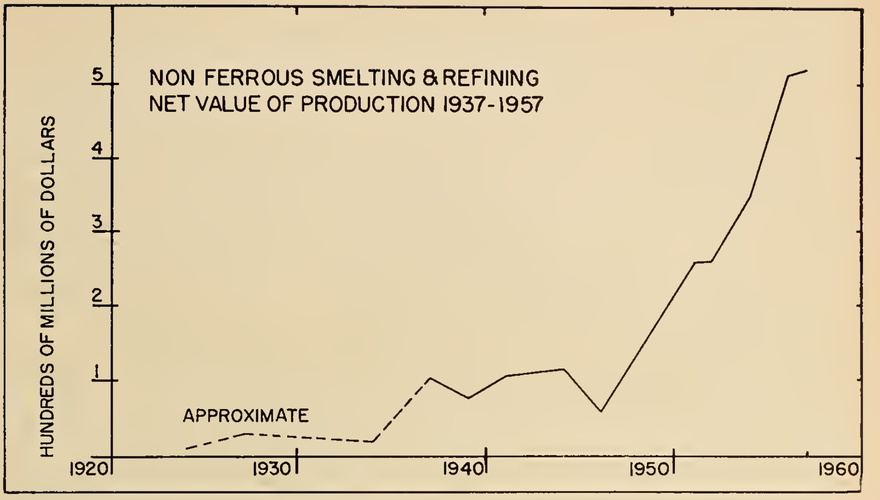
Cost of materials at all plants totalled $138.2 million. Value added by manufacture amounted to $121 million, while gross selling value of products was $260.2 million. Values of production by categories was made up roughly as follows: cans $88.5 million; bottle caps and seals $11.5 million; kitchen ware, $6.7 million; windows and screens $23.5 million; metal building material products $36.7 million; culvert pipe, $14 million; motor vehicle bodies $5.4 million; barrels and drums, $4 million; other products $70 million.

MISCELLANEOUS PRODUCTS

Based on preliminary reports, production by the miscellaneous iron and steel industry reached a value of some $160 million in 1957, which would be 40 per cent higher than shipments recorded in 1955 of $114.26 million. This industry includes the establishments not classified to any of the special groups into which the iron and steel industry is divided for statistical purposes. Products made include ornamental and architectural iron-work, steel forgings, safes, vaults, railway track equipment, mining machinery, steel wool, fireplace furnishings, horseshoes, chains, sanitary ware, etc.

Of the 347 firms reporting in 1955, last complete report available, 177 were in Ontario; 109 in Quebec; 33 in British Columbia; 13 in Alberta; 11 in Manitoba; 3 in Nova Scotia; and 1 in New Brunswick. These firms employed 11,207 persons of whom 9,340 were in Ontario and Quebec. Earnings totalled $39.8 million; materials used cost $46.6 million; value added by manufacture was $65.35 million; selling value of products totalled $114.26 million.

Products made were valued as follows: steel forgings, $17.2 million; architectural work, $16.8 million; sanitary ware, $16.4 million; structural shapes, fabricated, $3.5 million; safes, railway frogs, machinery, repair and custom work some $2 million each; and other products, $51.3 million.



SMELTING AND REFINING

Though the net value added by smelting and refining of non-ferrous ores or concentrates in 1957 has not been reported, a comparison of the total value of production in 1957 and 1956 for the principal non-ferrous metals indicates that there was little change in 1957 from the net value added by smelting and refining in 1956. Values of production were lower in 1957 for copper and zinc by some 33% and 20% respectively. On the other hand the production value of uranium was up almost three-fold, while value of nickel production was up 5½%.

The smelting and refining industry includes only those firms engaged primarily in smelting of non-ferrous ores or concentrates and in the refining of metals recovered therefrom. The smelting of imported ores is included, but secondary smelters, which treat scrap metals only, are not. The list of metals covered includes copper, nickel, lead, zinc, aluminum, magnesium, titanium, molybdenum, tungsten, cobalt, antimony, bismuth, cadmium, selenium, tellurium, and precious metals. Refining of crude oil is not included.

In 1956, the last complete year reported in full, 23 establishments had total employment of 30,788 persons, earning $130.14 million, and cost of ores and raw materials was $745.9 million. Cost of process supplies and containers was $74.68 million, gross value of products shipped including containers was $1,396.6 million and net value of production was $511 million.

Capacities of Canada's copper smelting and refining works in 1956 were as follows: Falconbridge nickel mines, 700,000 tons yearly of ores and concentrates from three blast furnaces; Hudson Bay Mining and Smelting Co., 575,000 tons of reverberatory capacity; Noranda Mines, 1,300,000 tons capacity from six blast furnaces and 3,500,000 tons reverberatory capacity from nine reverberators.

Capacities of electrolytic zinc plants include one of 200,000 tons annually at Consolidated Mining and Smelting Co., Trail, B.C., and one of 73,000 tons annually at Hudson Bay Mining Co. plant, Flin Flon, Manitoba. Consolidated Smelters, at Trail, B.C., also has five furnaces for lead smelting with annual capacity of 711,000 tons.

Fertilizer plant and concentrator at Kimberley, B.C., the site of the only lead refinery in Canada.

A second pneumatic alumina unloader was installed on the dock at Kitimat in 1957.

Canadian production of aluminum ingots in 1957 at some 534,800 tons was down 13% from the 614,721 tons produced in 1956, though imports of bauxite ore were some 9½% higher than in 1956. The decrease in ingot production was due in part to a drop in world consumption and a cut-back to 90% of capacity in the latter part of the year. It was also due to the prolonged four months labour strike at Aluminum Company of Canada's Arvida works. For the full year, dollar volume of sales was down only about 10%, reflecting price increases in the U.S. where a third of sales are made. Employment in the primary aluminum industry by the Aluminum Company of Canada, Limited, the only Canadian producer in 1957, averaged some 12,300 workers for the year.

In all world markets aluminum became freely available in 1957, replacing a supply shortage which, despite vigorous expansion efforts, had prevailed for nearly ten years. This return to easier supply may be regarded as a more normal state of affairs for the industry with supply and demand more nearly in balance.

Last October, Aluminium Limited indefinitely deferred completion of another 80,000 tons of capacity at Kitimat, which was to have raised total capacity of all its plants to 850,000 tons. Other phases of the expansion program, which had a target of close to a million tons yearly by the end of 1959, are also being held back.

Early in January 1958 the Company further curtailed ingot production by another 60,000 tons of annual capacity, to a point 20%, or more than 150,000 tons, below full rated capacity. Its principal operating subsidiary, Aluminum Company of Canada (Alcan), cut back operations at the Arvida and Shawinigan plants, by closing down 60,000 tons of smelter capacity. This resulted in layoffs of some 500 of the 9,000 employees of Alcan in Quebec. Construction of new hydro-electric facilities of a million horsepower on the Peribonka river is being continued, however, with first power to be available in 1959.

During the year, Canadian British Aluminum Ltd. completed the first stage of its four-stage 180,000-ton capacity smelter at Baie Comeau, Quebec. The smelter represents an investment of $77 million in the first two stages of 45,000-ton capacity each, with decisions on the third and fourth stages to be taken in 1959 or later. Manicouagan Power Co., in which Canadian British Aluminum holds 40 per cent interest, has expanded output from 100,000 h.p. to 250,000 h.p. to supply the smelter from its power site 11 miles away. At year-end production started with pouring of the first ingot.

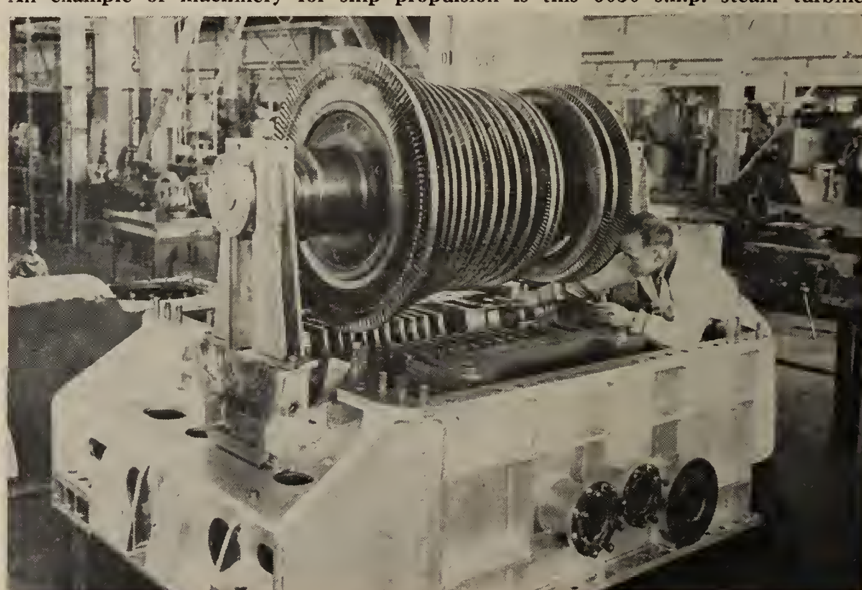
Reflecting the new availability of metal, Alcan has stepped up sales and research activities to develop expanded markets. Promising results are reported being achieved in the fields of transportation equipment for railroad and water transportation, in containers and packaging, electrical equipment, and in architectural uses.

The Aluminum Products Industry

This industry comprises the operations of factories chiefly occupied in the fabrication, casting or rolling of aluminum to make bars, sheets, wire, cable, foil, and cooking utensils. It does not include primary aluminum smelting or castings, cable, utensils, and the like, made as secondary or minor products in brass or iron foundries.

In 1955, last year for which a full report is available, there were 93 factories, 22 of them in Quebec, 59 in Ontario, and 12 in western provinces. There were 6,832 employees in factories, two-thirds of them in Ontario, who received wages of $24 million; cost of materials purchased amounted to $45,961,000; value added by production was $31,733,600; and gross selling value amounted to $79,839,600. Imports amounted to a value of $19.97 million, divided as follows: plates and strips $2.94 million; kitchenware $2.04 million; other manufactures $11.2 million. Exports were valued at $212.7 million, of which $197.6 million was in primary form.

An example of machinery for ship propulsion is this 6050 s.h.p. steam turbine.



MACHINES AND EQUIPMENT

Based on preliminary reports, for the first nine months of 1957, the value of shipments by the industrial machinery industry at some $372.5 million showed an increase of about two per cent over the value of shipments in 1956 of $366 million.

This industry covers operations of iron and steel works occupied chiefly in making industrial, household, office, and business machinery, and machine tools. Farm and electrical machinery and supplies are covered elsewhere. Some concerns in other industrial groups make machinery as secondary or minor products, so production figures quoted do not represent total Canadian output.

In 1955, the latest year for which a full report has been published, there were 408 establishments which together employed 33,308 workers. Salaries and wages totalled $119.2 million; materials cost $153 million; value added by manufacture was $210.6 million; and gross selling value of products totalled $368.4 million. Of the 33,308 employees 92% were employed in Ontario and Quebec.

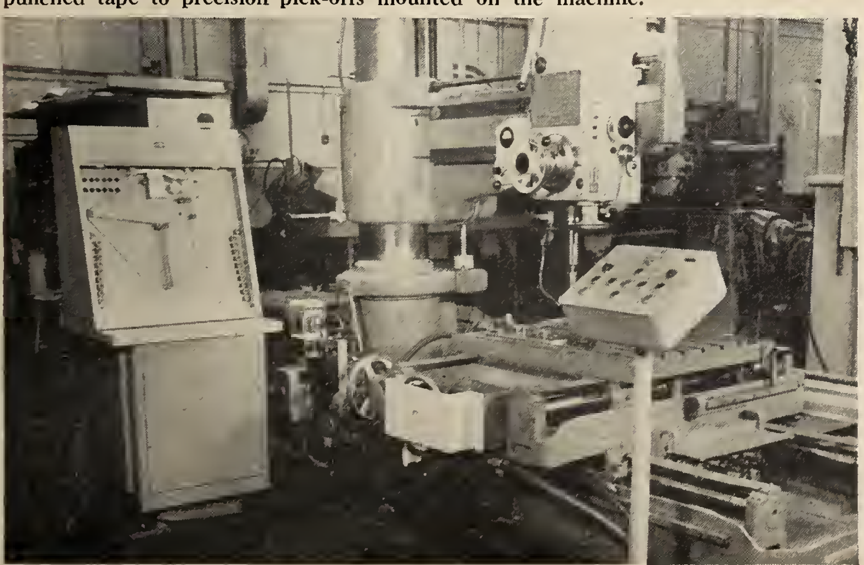
Values of production for some of the larger categories included: power shovels, glass blowing and rolling mill machinery, $38.5 million; household machinery and parts, $39.2 million; office business and store machinery and parts, $37.6 million; ventilating and dust collecting machinery, $18.0 million; pumps and parts, $18.5 million; mining and metallurgical equipment, $18 million; steam diesel and gas engines, $17 million; pulp and paper mill machinery, $15.3 million; conveying and elevating machinery, $13 million; elevators, $12.5 million; refrigerating machinery, $7.9 million; road making, ship, service station, metal working, hoisting turbine, woodworking, and air compressor machinery, about $6 million each.

MACHINE SHOPS INDUSTRY

The machine shops industry includes all independent machine shops occupied chiefly or solely in custom machining or repair work and which have gross yearly incomes exceeding $5,000 each. Smaller shops with less than $5,000 worth of business are not included, nor are shops operating in connection with factories, mines, paper mills, etc. Shops which make a regular line of products for sale are classed as manufacturing plants and are included in the appropriate industries. The industry has shown a steady growth since 1941 excepting for decreases in 1945 and 1946, and value of production has increased almost fourfold since 1941, while employment more than doubled.

In 1955, most recent year a full report was issued, a total of 674 shops —more than half of them in the two central provinces — employed 6,814 persons who earned $21.4 million. Cost of materials used was $15.83 million; value added by manufacture amounted to $31.72 million; and gross value of work done totalled $48.9 million. Nearly three quarters of the value of work done was by incorporated companies or co-operatives, the balance by shops under individual ownership or partnership.

A machine tool control, here used in conjunction with a spacer table, which is a device for positioning a table, carriage or tool part to ±0.00025 inch to one, two or three axes. Dimensional information is fed from a decimal keyboard or punched tape to precision pick-offs mounted on the machine.



AGRICULTURAL IMPLEMENTS

This industry covers only firms which produce agricultural implements as their main product. However, some firms classified in other groups produce implements as a minor part of their production. The latter are excluded from statistics on employment and value of shipments. Preliminary reports of shipments during 1957 indicated a total value of some $112 million for that year.

In 1955, most recent year for which a full report is available, there were 77 factories in Canada employing 11,753 workers. Of these, 29 plants in Ontario accounted for 93% of the total employment. Earnings totalled $41.9 million; cost of materials used totalled $59.3 million; value added by manufacture was $54.46 million; and gross selling value of products amounted to $113,923,000. This compared with the peak year of 1952 when 18,000 workers produced implements valued at $205.8 million.

In 1955 the agricultural implement industry produced implements valued at $109.7 million. Implements valued at $178.2 million were imported, while implements valued at $76 million were exported. Sales in various regions were divided as follows: Atlantic provinces, $6.8 million; Quebec, $21.7 million; Ontario, $43.8 million; Prairie Provinces, $77.6 million; British Columbia, $5.2 million. Values of imports of some of the major types of implements were as follows, in round figures: tractors, $115 million; harvesters, $15 million; pruning hooks and shears, $10 million; hay presses and parts, $7.8 million; dairy machinery, $5 million. Reaper threshers were the principal item exported.

Values of principal types of farm implements produced in 1955 from *all* Canadian industries in millions of dollars was; plows, $4.6; mowers, $5.0; harrows, $3.1; grain binders, $0.06 (down from $2.3 million in 1947); threshers, $36.4; seed drills, $0.8; cream separators, $0.2; discs, harrow plows and tiller combines, $1.7; cultivators, $2.8; weeders and cornplanters, $0.2; hayloaders, $2.2; manure spreaders, $1.7.

Sales of farm implements and equipment in 1956 to Canadian customers, including imports, but excluding export sales, amounted to

$170.77 million, an increase of 11% over the previous year. This value is at wholesale prices. Information supplied by manufacturers and importer-distributors indicates an average mark-up of 23.7% would produce a reasonably accurate estimate of expenditures by Canadian farmers on new implements and equipment in 1956. On this basis retail sales were estimated at $211.2 million. Sales in the prairie provinces accounted for about 70% of the total. Sales of repair parts at $31.8 million were up from the previous year.

HARDWARE TOOLS CUTLERY

From preliminary reports covering the first nine months of 1957, production of hardware, tools, and cutlery at some $153 million was 19% lower than the production valued at $191 million in 1956.

The most recent complete report of the hardware tools and cutlery industry was for the year 1955, when 370 establishments employed a total of 13,115 persons who earned $44.58 million. Of these, 2,731 worked in 272 Ontario plants, while 76 plants in Quebec employed 2,779 persons. British Columbia employed 506 persons; Nova Scotia and New Brunswick employed 38; Manitoba 33; and Alberta 28. Cost at plant of materials used was $49.2 million, value added by manufacture totalled $83.5 million, and gross selling value amounted to $133.57 million.

Products in various categories made by the industry in 1955 were valued roughly as follows; razors and blades, scissors and knives, $5.3 million; hardware, $26.2 million; hand and small tools, $20.8 million; hand implements, $4.1 million; tungsten carbide products, $6.6 million; bolts, nuts, rivets, washers, screws and allied products, $24.4 million; casters, dies and saws, $23.5 million; other products $22.4 million.

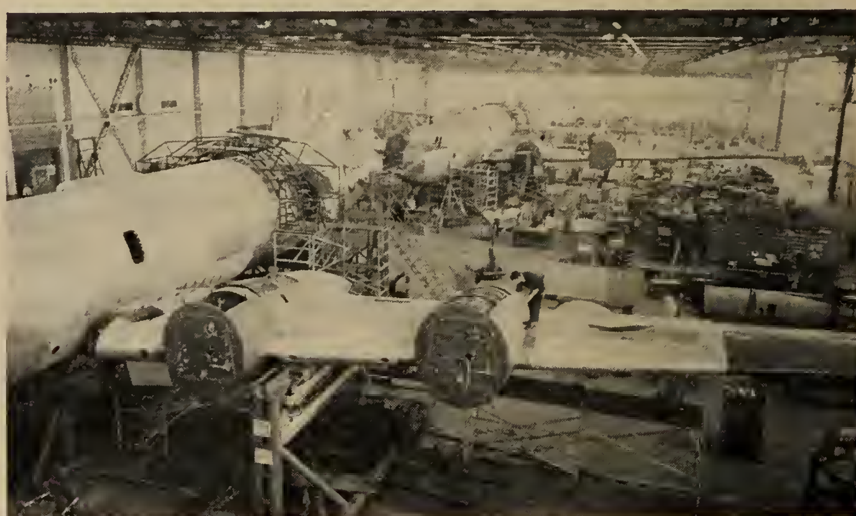
Imports during 1955 of various items of hardware, tools and cutlery added up to a value of more than $45 million, while exports amounted to a value of $269,000.

HEATING AND COOKING APPARATUS

This industry is a division of the iron and steel group and includes only factories making stoves, furnaces, oilburners, etc., as their chief products. Production includes as minor some iron castings, machinery and other items, which do not normally belong with the industry. Some heating equipment was made as secondary products of concerns classified with other industries.

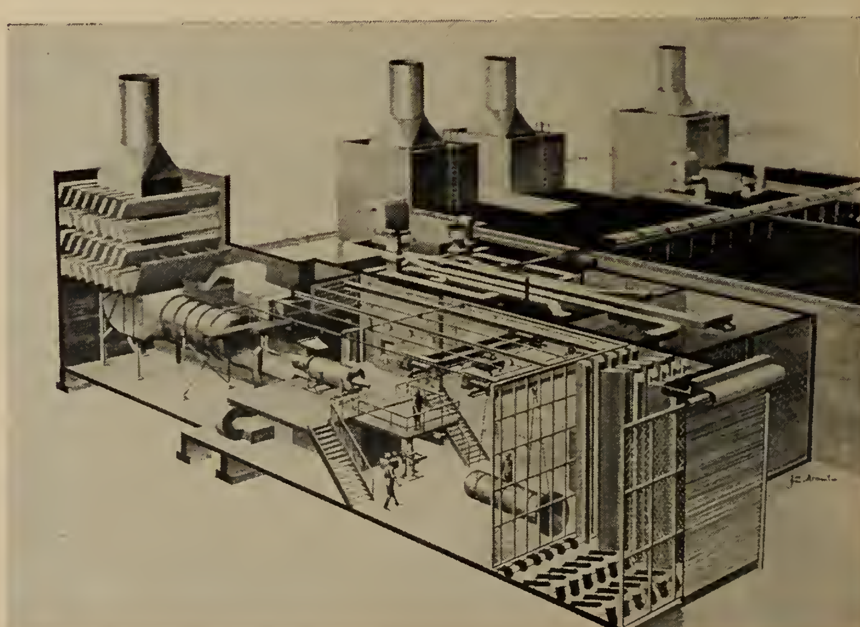
In 1955, latest year for which a full report has been published, 123 factories employed 9,148 workers, 5,980 of whom were in Ontario and 1,825 in Quebec. Total earnings were $29.8 million; materials used cost $56.76 million; value added by manufacture was $55.4 million and value of factory shipments totalled $113 million. No reports on production during 1956 and 1957 are available.

Factory shipments from all industries in 1955 by categories were valued as follows:—electric stoves, $40 million; other stoves $9.6 million; domestic watertank heaters, $6.6 million; oilburners, $11.3 million; furnace blowers, $1.76 million; mechanical stokers, $916,000, unit heaters, $4.43 million; air registers and grills, $1.84 million; heating radiators, $10.3 million; warm air furnaces, $24.1 million; and heating and power boilers, $18.08 million.



AIRCRAFT MANUFACTURE

Above is part of the assembly line of the CL-28 'Argus' anti-submarine aircraft. Below is a view of the aero-engine test cells of Orendâ Engines Limited, showing splitter vane intake-air silencers, right, test bed and working platform, centre, and exhaust silencing system at left.



TRANSPORT EQUIPMENT

AIRCRAFT

The year 1957 was one of outstanding achievement for the Canadian aircraft industry. Highlights included R.C.A.F. acceptance of the 'Argus' CP-107 submarine hunter, maritime reconnaissance version of the Britannia, largest aircraft ever produced in Canada; the unveiling of the 'Iroquois' by Orenda Engines Ltd., world's most powerful jet engine; and acceptance of Avro's CF-105 'Arrow', Canada's first supersonic fighter.

Industry Pattern

In 1955, latest year for which a complete report was published, 52 establishments employed 33,036 persons, who earned $130.3 million. Twenty-three Ontario plants employed 19,036 of the total, Quebec's 24 plants employed 11,066, while Nova Scotia, Manitoba, Alberta, and British Columbia between them employed 2,934. Cost of materials used was $140.8 million, value added by manufacture totalled $208.8 million, and gross selling value amounted to $354.3 million. The year 1944 established an all-time peak, when 45 plants employing 79,572 persons produced aircraft and parts valued at almost $426 million.

The industry is made up of primary assembly plants and establishments occupied solely or chiefly in making parts. In the four assembly plants which constitute the core of the industry there were 19,343 workers in 1955. Output for complete aircraft totalled $108.4 million while the remainder of the output at $245.9 was for parts.

During the same year 470 complete aircraft, not including engines, valued at $51.42 million and aircraft parts valued at $86.67 million were imported. Aircraft engines totalling 1,236 valued at $15.3 million and engine parts valued at $18.1 million were also imported. Exports and re-exports of aircraft and parts totalled $19.9 million for exports and $2.12 million for re-exports.

Canada's aircraft industry, ranking third in employment and ninth in volume of sales, in 1956 had 38 establishments employing some 35,000 persons and showed production valued at $360 million. Preliminary figures for the first three quarters of 1957 indicate employment rose about 10 per cent over the previous year, while sales somewhat exceeded the value reached in 1956. This prediction is based on a 16 per cent higher traffic for air carriers, on Canadian defence expenditures about equal to those of 1956, plus outstanding success in the export field.

Aircraft Production and Exports

Other projects for defence under way during the year included the CL-44 military transport for the R.C.A.F., with first delivery scheduled for late 1959.

In June, Belgium placed an order for 54 Avro CF-100 Mk. V's for NATO. Canadair Ltd. announced in November its decision to proceed with production of two prototypes of its ab-initio jet basic trainer, the CL-41, while CAE Ltd. of Montreal delivered the first of twelve CF-100 flight simulators to the R.C.A.F.

Placing in production of the CF-105 Avro 'Arrow' interceptor in November, however, with an initial order for 40 valued at some $300 million, replacing the CF-100's, assured the 650 firms holding subcontracts of continuing employment for some 15,000 workers. Yet for the industry the project is a big gamble. Much was spent on tooling-up and cancellation would be a serious blow.

Outstanding events during the year relating to export included commencement of work by Canadair Ltd. on an order from the West German Republic for 225 Sabre VI's, an order representing a value of $80 million including 400 Orenda-14 turbojet engines and parts; licensing agreements with Bristol Aircraft Ltd. for production and sale of Canadair-modified commercial versions of the 'Britannia' to be powered by Bristol Orion propeller engines; and permission from the American Defence Department to place an evaluation order to de Havilland Aircraft of Canada for five 'Caribous'.

Another event of importance was Canadair's decision to build passenger and cargo versions of the CL-44 for intercontintental routes. Powered by four Bristol 'Orion' engines they will have a range of 5,000 miles, with capacity of 150 passengers or 35 tons of cargo, and will be the second largest civil turboprops in the world.

As the year ended, the Air Industries and Transport Association began preparing for talks with the government, with a view to making a concerted effort to eliminate the 15 per cent tariff now imposed by United States on aircraft imported from Canada. No similar Canadian barrier against aircraft imports into Canada is in force.

Missile Production

Events in the final quarter of 1957 focussed attention on the production of guided missiles in Canada—a matter long subject to vacillation and indecision. Requirements for all three services have been long under study. So far Canada's missile potential is concentrated on the air-to-air variety. The costly all-Canadian 'Velvet Glove' programme has been succeeded by a licensing arrangement for production of a suitable American missile.

Late in the year Canadair Ltd. and Canadian Westinghouse, respectively responsible for airframe and guidance systems, were at last able to begin tooling up for 'Sparrow' production. Much of the program will be sub-contracted.

The Royal Canadian Navy is known to be interested in both an air-to-air and air-to-ship system. Army interest is in ground-to-ground and ground-to-air missiles. What steps will be taken to meet these requirements will depend on the final outcome of discussions which took place between

Working on a mock-up of Canadair's new side-by-side jet-powered basic trainer.

Canada's top defence officials and NATO representatives at the NATO meeting last December. Meantime a number of Canadian firms, such as de Havilland, have been building up trained staffs for missile research.

Other aircraft industry production during the year, for defence, though not classified as aircraft production, included a tracked vehicle developed by Canadair for the army for use in the Arctic. One of these vehicles, capable of carrying personnel or cargo weighing half a ton and of towing another half ton, after rigorous trials was taken to Antarctica by a U.S. government expedition.

Canadair's nuclear division also completed two major installations for Atomic Energy of Canada Ltd. at Chalk River, namely, a pool test reactor and a spectrometer, both for use with other atomic reactors.

MOTOR VEHICLES

The canadian automotive output in 1957 fell more than 13 per cent below that of the previous year. This resulted from a ten-month slump in commercial vehicle construction and monthly outputs lower than the previous year for passenger vehicles during the last three quarters. The nation's assembly plants shipped 409,821 vehicles in the 12 months, compared with 470,674 in 1956. Passenger car production at 340,014 units was 9 per cent under the previous year, while commercial vehicle output at 71,478 units was 29 per cent lower than in 1956.

Employment in the industry averaged 39,000 persons for the year, down 3 per cent from the 1956 average of 40,253 persons. Payrolls for 1957 were close to the $170 million paid out in 1956, the largest in the history of the industry. The year was relatively free from strikes.

The only auto manufacturer to score a gain over 1956 was General Motors of Canada, whose passenger car total surpassed the previous year by 3½ per cent. Ford Motor Co. output declined eight per cent; Chrysler Corporation output fell 25 per cent; Studebaker and American Motors dropped 37 and 68 per cent, respectively, below the previous year. Percentage declines suffered by Canadian truck manufacturers were: General Motors 30; Ford 17; Chrysler 42; International Harvester 68.

This made General Motors the leading producer for the year with 153,417 passenger cars; followed by Ford and Chrysler in that order with 109,889 and 69,418 passenger cars respectively, giving GM 45.1%, Ford 32.3%, and Chrysler 20.4% of the total.

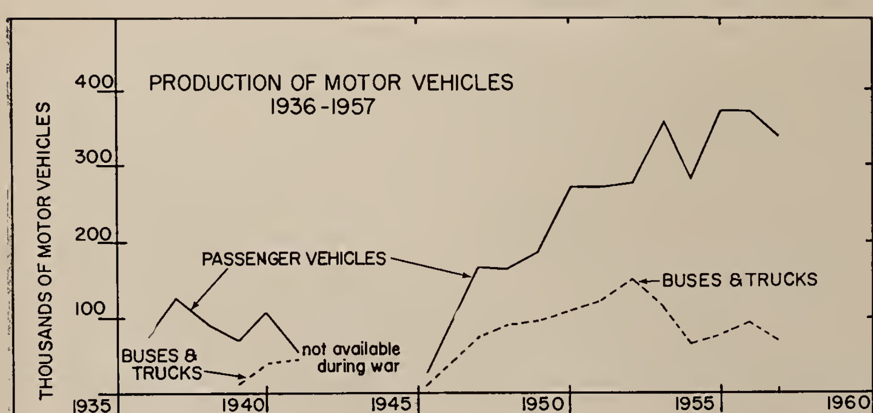
Factory shipments of made-in-Canada vehicles for 1957 will total some 409,821 vehicles, 13 per cent below the previous year. Sales of cars and trucks during the first four months were the greatest in the industry's history but did not hold at this level during the later months. The sharp decline was due to a tightening supply of credit and to the lack of ready cash in the hands of the industry. Lack of industry funds hit the truck market particularly, forcing reappraisal and postponement of truck purchases by many business men.

Despite such problems, passenger car sales during the year 1958, according to industry observers, should reach some 380,000 units, close to the 1955 level and only 7 per cent below the 1956 record of 408,000 units. The estimated number of vehicles of all types withdrawn from service has ranged from 160,000 to 202,000 over the past four years, 75 to 85 per cent of which were passenger vehicles.

Truck sales at 78,000 were 15 per cent under 1956 and about equal to 1955 sales. Truck exports at 7,500 units, were at a six-year low. The decline in exports was mainly due to the Suez crisis and in some measure to the scarcity of Canadian dollars abroad.

Imports of European vehicles took a larger slice of the Canadian passenger car market, accounting for nearly 12 per cent of total sales during the first three quarters of the year. This represented a 61 per cent increase over the same period of 1956, and showed increasing percentages of 9, 12½, 13½ and 17½ per cent for the first, second, third, and fourth quarters respectively.

With an expected easing in credit and money supply during the coming year, together with the reduction last year on the excise tax on automobiles from 10 per cent to 7½ per cent, auto manufacturers are looking ahead to a higher volume of purchasing power and better sales in 1958 than in the year just passed. The year 1958, however, started badly, with a 55,000-man-day lay off in January by Ford and Chrysler following the 17% cuts in December.



The Industry in 1956

A measure of magnitude of the Canadian Motor Vehicles Industry is seen in the 1956 report compiled by D.B.S., the latest year for which full statistics are available. In that year factory shipments valued at $988.1 million showed an increase in value of 8.9 per cent over the previous year. Value of finished vehicles amounted to $836.7 million, while parts and miscellaneous products accounted for $151.4 million.

All vehicles shipped from factories during the year totalled 467,864 or 3.1 percent more than in 1955. Passenger cars produced totalled 374,312, of which 24,500 were made for export; trucks produced totalled 93,157, of which 8,410 were made for export; buses numbered 395, of which 48 were made for export. Actual export of all vehicles totalled 19,034 valued at $22.5 million. Imports amounted to 89,232 units worth 171.4 million.

The industry in 1956 included 16 establishments, nine of which were located in Ontario and seven in other provinces. Employment at 35,100 (97 per cent of which was in Ontario) was 1,700 higher than in the previous year. Wages and salaries at $149,948,000 showed a 10 per cent increase. Expenditures for fuel and electricity totalled $5.98 million; cost of material at works was $697.3 million; and value added by manufacture amounted to $298.2 million.

Growth in Registrations, Revenues, and Gasoline Consumption

The 1956 registration year brought a 7 per cent increase in the number of motor vehicles licensed in Canada to 4,230,647. Passenger car registrations were up 8.6 per cent at 3.187,099, while commercial vehicle registrations were up 3.2 per cent at 1,007,968. Motorcycles and motorized bicycles fell slightly to 35,580. Increases by provinces in order of magnitude were: Newfoundland 15%; Quebec 11%; British Columbia 10%; Manitoba 7%; Alberta 6.8%; Yukon & N.W.T. 6.6%; Saskatchewan 5.9%; Ontario 5.7%; and New Brunswick 4%.

At the end of 1956 there were ten motor vehicles registered for every 38 Canadians. Alberta's ratio was the highest with ten for every 29 persons, while Ontario led in passenger cars at ten per 39 persons. All regions showed increases over the previous year in vehicles *per capita* except Nova Scotia. During the 12-year period 1945 to 1956 there was an increase of 186% in all motor vehicles registered, 175% in passenger cars, and 212% in commercial vehicles.

During 1956 Provincial and Territorial governments collected $422.5 million in revenues from gasoline taxes and the licensing of vehicles, drivers and dealers, 11.8 per cent more than in the previous year. Consumption of taxable gasoline for automotive purposes at 2,457 million gallons was 10.3 per cent higher than in 1955. Increases in tax per gallon included Prince Edward Island from 13 to 16 cents; Ontario from 11 to 13 cents; and Saskatchewan from 11c to 12c.

A general view of assembly-line operations at Canadian Car's Fort William bus plant.

Motor Vehicles Parts Industry

This industry includes only factories which made parts and accessories as their chief products. Parts such as tires, batteries, brake linings, etc., made in other industries are not included, nor are lacquers and upholstering, etc. Among products made are included engines, bodies, differentials, transmissions, radiators, spark plugs, starters, axles, piston rings, wheels, glass, trailers, springs, bumpers, steering gears, hubs, lubricating systems, etc.

No statistics for the industry are available for 1956 and 1957. For 1955, however, a complete report showed 180 establishments, 108 of which were in Ontario, 23 in Quebec, 18 in British Columbia, 17 in Alberta, 14 in Manitoba, 5 in Saskatchewan, 2 in New Brunswick, and 1 in Nova Scotia. The industry employed 20,000 people, who earned $74.6 million. Total production of specified parts and accessories from all industries including tires, batteries, radios, etc. amounted to $523.1 million compared with $406.3 million in 1954. Imports of parts during 1955 totalled to a value of some $278 million, while exports were valued at $24.7 million.

New 2400-h.p. diesel-electric locomotive in test service on Canadian railroads is designed for special heavy-duty freight and high speed passenger service.

RAILWAY EQUIPMENT

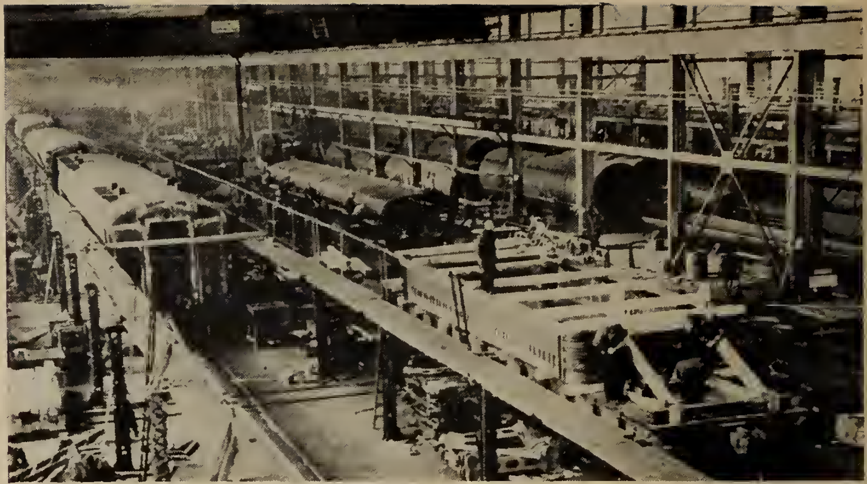
Canada's 29 establishments which furnish railroad equipment to Canada's railroads enjoyed an excellent year in 1957. Some 11,350 freight cars of all types were delivered to the two principal railway systems alone, compared with 9,214 for the entire railroad industry the previous year. Diesel locomotive production continued at about the same rate as during the previous year when 446 units were produced. One hundred passenger units and 152 units of work equipment were delivered to Canadian National. The preliminary reports indicate shipments in 1957 reached a value of some $380 million or 10 per cent higher than the peak of $345.5 million reached in 1956.

The annual review of the industry covering the year 1956, recently off the press, showed a reversal in 1956 of the downtrend in output obtaining since the year 1953, when gross value of production reached an all time peak of some $338 million. Gross value of production for 1955 at $245.7 million was the lowest since the late 'forties'.

For 1956, twenty-nine establishments, 12 of them in Ontario, employed 28,118 persons, purchased materials valued at $207 million, added $134 million by manufacture, and produced goods with gross selling value of $345.5 million. Comparable figures for the previous year were 32 establishments, 25,400 employees, material purchases $1,395 million and gross selling value of $245.5 million.

This industry includes all establishments chiefly occupied in making railway cars and locomotives, and component parts such as wheels, brakes, tires, bolsters, springs, etc. The principal repair shops of the C.N.R. and C.P.R. are included. These are located in the province of Quebec, which accounts for nearly half the employment in the industry.

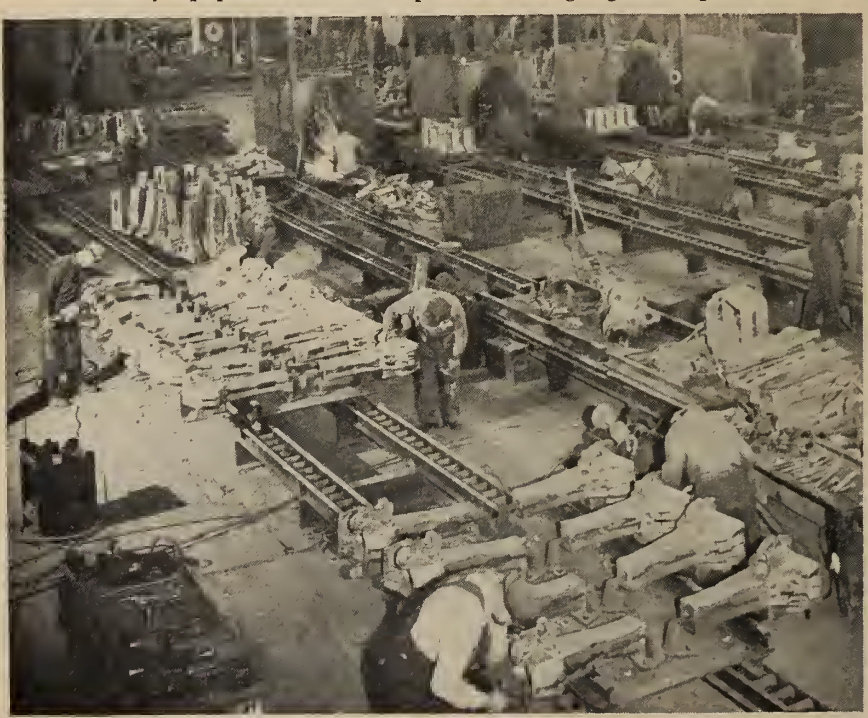
There were 29 establishments in 1956 with 28,118 employees whose total earnings were $100.73 million. Numbers employed by provinces were as follows: Quebec 12,596; Ontario, 6,268; Manitoba, 4,956; Nova Scotia and New Brunswick, 2,246; Alberta and B.C., 2,052. Output of materials included new railway cars valued at $71 million, new locomotives valued at $78.2 million, and other lines, such as wheels, parts for railway cars and locomotives, repair work, etc. Rail fastenings were valued at $12.6 million, while car wheels were valued at $6.5 million, and spikes at $2.2 million.



Railway coaches and tank cars under construction.

Looking ahead to the future, equipment manufacturers already had firm orders at year end from the two main railway systems for cars and locomotives totalling over $100 million in value for 1958 delivery. Completion of the C.N.R. and C.P.R. dieselization programs by 1961 calls for some 1,500/1,700 more diesel units or an average of 400 units yearly, though orders placed by year end totalled only some 266 units.

Railway equipment includes couplers and draught gear components.



Also at year end railway car builders held orders for some 4,000 freight cars of various types for 1958 delivery. This compares with an average of some 8,100 freight cars annually over the years 1955/56, and 1957. In the latest request from Canadian National, however, boxcar orders were conspicuously missing. In addition, car makers have orders from a number of the nation's smaller railroads, as well as from some industrial concerns.

SHIPBUILDING

CANADIAN SHIPYARDS enjoyed a reasonably active year in 1957, with most of the yards busy. Besides a very active naval programme, orders for a diversified range of commercial vessels for Canadian coastal trade helped to maintain monthly average of employment at around 14,900 workers on shipbuilding and repairs during the first three quarters. During the last quarter, however, with the current naval program drawing to a close, employment fell by some 1,500 as workers were dropped from the payrolls. Further layoffs were pending during the next few months as the remaining seven destroyer escorts neared completion.

Sixteen naval vessels were added to Canada's navy during the year: these included four destroyer escorts, five minesweepers, two ocean tugs, four crane lighters, and an ammunition lighter. Vessels for other departments of government included the R.C.M.P. patrol vessel, *Victoria,* the icebreaker *Montcalm,* the lighthouse tender *Montmorency* and the auto passenger ferry *Lord Selkirk.*

Specialized types of vessels built

for domestic commercial owners to serve differing modes of water transportation included a "canaller", an oil tanker, a bulk freighter, a "coaster", four dredges, a drill boat, a river ferry, a tug, and twenty barges. No ships were built for export. The commercial ship-repairing business showed an improvement on the St. Lawrence and on both coasts, but this trend was reversed later in the year due to the sharp drop in ocean freight rates, which caused owners to tie up many vessels.

Tenders were called early in 1958 for a stepped-up government shipbuilding programme to provide winter work. It will include six new vessels at a cost of $10-million and conversion of two wartime tank landing craft for carrying cargo to DEW line sites in the Arctic. Tenders will be called in February for a small ferry to operate between Pelee Island and the Ontario shore of Lake Erie.

Shipyard employment, while slightly better than that obtaining during 1956, was considerably lower than in 1954, last year for which complete statistics are available. During that year 76 shipyard establishments had more than 19,000 persons on their payrolls. Employment in the past year was only about one-fifth of the number employed in shipyards during 1943, the most active year in the industry's history.

What the longer-term future holds for Canadian shipbuilding, as far as domestic commercial shipping is concerned, depends on the report of the Royal Commission on Coastal Trade appointed in 1955, and the Government's decision regarding its recommendations. At present, ships built and registered in the Commonwealth have equal rights with Canadian ships within Canadian waters. If after completion of the Seaway this is not changed, consequences will be disastrous for Canadian shipyards. Many Canadian coastal operators are delaying construction pending results.

A shipbuilding and ship repairing industry in Canada with adequate and continuing production is an indispensable need, if the Royal Canadian Navy is to be supplied with the latest and best ships, ready to serve as an effective deterrent force. In a troubled world Canada cannot afford to allow her shipyards to close down.

PULP AND PAPER: Two of the industry's latest mills. Columbia Cellulose, top; North Western Pulp and Power Limited, Hinton, below. **(See review on pp.119-122.)**

BOAT BUILDING

THE BOAT BUILDING industry comprises firms making small vessels and pleasure craft such as row boats, canoes, sailboats, motor boats, etc. The 204 plants reporting for 1955, last year for which a full report is available, were distributed as follows: Ontario, 61; British Columbia, 58; Nova Scotia, 36; Quebec, 36; Manitoba, 7; New Brunswick, 3; Alberta, 2; and Saskatchewan, 1. Employees numbering 1,666 earned $4.18 million, materials used cost $4.4 million, value added by manufacture totalled $5.54 million, and gross selling value amounted to $10.27 million. Ontario's production from 61 plants at $4.8 million accounted for nearly half of the total.

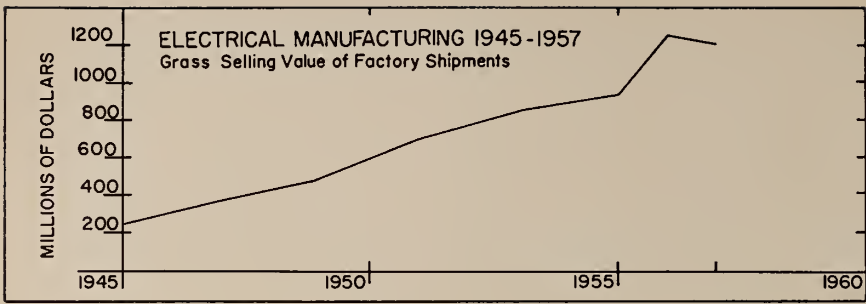
Production by categories (and values) included: 12,166 outboard boats ($3.2 million); 474 motor boats ($2.2 million); 11,049 other boats ($1.7 million); 3,689 canoes ($272,-500); rowboats, skiffs, dories, etc. ($331,800); 154 sailboats ($92,000); and other products valued at some $2.5 million.

MISCELLANEOUS EQUIPMENT

To round out production of transportion equipment, records of the miscellaneous transportation equipment and of the bicycle industry should be included. The former produces carriages, sleighs, bodies and boxes for vehicles, wheels, wheelbarrows, and baby buggies. The latter produces, bicycles, tricycles and bicycle parts, ice skates, children's wagons, strollers.

In 1956 the miscellaneous transportion equipment industry included 27 firms employing 886 persons who earned $2.47 million, cost of materials totalled $5 million, value added by manufacture amounted to $5.04 million and gross selling value of products totalled $10.1 million.

The bicycle industry in the same year included five establishments employing 627 persons who earned $2.19 million. Two plants were in Quebec and three in Ontario. Materials used cost $2.06 million. Factory shipments amounted to 100,884 bicycles valued at $3.11 million at factory prices; gross selling value totalled $6.42 million.



ELECTRICAL EQUIPMENT

Preliminary Estimates indicate the 1957 output of manufactured goods by the Canadian electrical manufacturing industry will reach a value of some $1,200 million, a decline of two per cent from 1956's figure of $1,226 million.

Pattern of the Industry

In 1955, most recent year for which full statistics are published, employment in the industry totalled 76,244 persons. Factory shipments at $962.6 million showed an increase of 11.4% over 1954. Output of electrical apparatus in other industries including electrical accessories for automobile and household use but excluding office and industrial machinery amounted to $131.5 million. Shipments of subgroups were valued in millions of dollars as follows: batteries $40.6; heavy electrical equipment $198.4; radios and parts $263.4; refrigerators and appliances $135.67; miscellaneous wires and cables $155.96; other miscellaneous electrical products $169.1.

Principal imports during the year, in millions of dollars, included: electrical apparatus n.o.p. and parts $24; radios and wireless apparatus $61; refrigerators $17.8; refrigerator parts $16.1; electric motors $12.8; radio tubes $12.8; telephone apparatus $12.2; generators and parts $10.2; switches and switchboards $11.4; heating and cooking apparatus $11.3; generators and parts $10.2; farm freezers $9.6; radio receiving sets $8.9; rheostats $8. Principal exports included: radio and wireless apparatus $4.8; electrical apparatus n.o.p. $4.22; spark plugs $2.1; telephones and apparatus $2.07.

Levelling of Expansion Programs

The year 1957 was one of challenge for electrical manufacturing as the various divisions of the industry adjusted to meet the changing needs of the Canadian economy. The year saw a levelling-off in industrial expansion programs as well as a decline in demand for consumer goods, largely caused by the sharp reduction in housing starts and a tight money supply. Working off a backlog of orders, heavy apparatus manufacture continued at a high level in 1957, but demand for consumer durables and the associated industrial products declined faster than had been expected.

Appliance Market Weaker

The Federal monetary policy followed during the past year, and its results, were largely responsible for a sharp decline in sales of major appliances. Refrigerator sales were down 15%, range sales were down 14%, and wringer-washer sales were down 9% from 1956. However, automatic laundry equipment continued to show a growth trend with sales increasing by 11% over 1956.

Present indications are that for 1958 major appliance sales generally will at least equal the 1957 volume. Low saturation levels should continue to provide growth potential for automatic laundry equipment. Based on the assumption that recent monetary policies will be continued, particularly for residential construction, range sales should reach the 1956 sales level, with built-in ranges reflecting the greatest sales growth rate in this segment.

Yet Canadian appliance manufacturers are becoming increasingly concerned at the extent to which American-built appliances are invading the domestic market, with a resultant drop in production and dislocation of employment in Canadian appliance plants. The products most effected are refrigerators, laundry equipment, and, to a lesser degree, ranges. Despite this invasion of the Canadian market, however, domestic appliance manufacturers are not asking for increases in tariff protection.

Apparatus Market was Strong

During 1957, the heavy capital goods segment of the industry produced a record volume of apparatus of utilities and industries. This equipment is basic to the capital expansion programs which have been such dominant features of the economy for the past several years.

For power production, deliveries of waterwheel generators, power transformers and circuit breakers were at peak levels. In 1958, the industry expects a new high in production of waterwheel generators, though a somewhat lower volume of production of transformers and circuit breakers is seen for the coming year. The mining industry, too, placed a heavy volume of orders on apparatus manufacturers in 1957, as did expansion programs at Canadian steel mills.

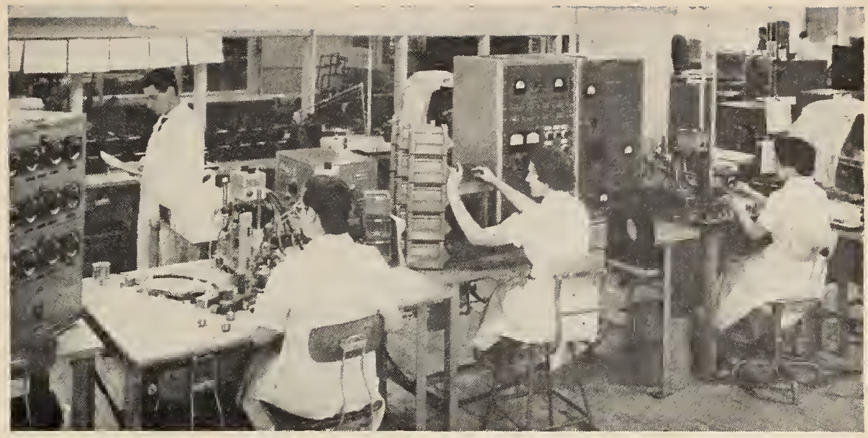
Looking ahead, the apparatus segment foresaw some softening in orders from Canadian utilities. Industrial business is expected to level off to a somewhat greater degree as industries digest recent expansion programs. The rapidly expanding petrochemical industry, however, will create a source of new apparatus business while a moderate continuing demand for equipment is expected to support the modernization and expansion plans of the steel industry.

It is becoming increasing evident that Europe will be the world's first large market for economic nuclear power. It was reassuring to note the enthusiasm of Euratom's "Three Wise Men" concerning the Canadian power reactor design and development program. Canadian design is based on fuelling with natural rather than with enriched uranium which, in the Free World, is largely controlled from the U.S. Natural uranium, on the other hand, has many important sources throughout the world and supply will be comparatively free.

Big Market in Thermal Power Equipment

Over 3½ million h.p., or 16 per cent of Canada's generating capacity is now thermal. There will be growing trend toward thermal generation of power as full development of the few remaining hydro sites within economical transmission distances of population centres is completed. Seaway power, for example, represents the last major source of hydro-electric power in Southern Ontario.

Because of this expanding market for thermal power equipment, Canada's electrical manufacturers are actively studying the possible manufacture of turbo-generator units and other equipment for use in thermal plants. At present all such equipment in Canada is of foreign manufacture. But here Canadian electrical manufacturers face a double handicap. They would compete with manufacturers in low-wage-level countries overseas and, to start with at least, would have no tariff protection from certain overseas producers. Yet in the years to come Canadian electrical manufacturers may become world leaders in thermal generating equipment, as they are now in the hydro-electric field.



Dry reed switches for electron tubes being made in an air-conditioned area.

TV Market Down, Radio and Players Up

Television receiver sales declined by some 27% during 1957, but now appear to have reached a level which will be maintained over the next year. The industry expects that TV set sales in 1958 will be in the order of 470,000 sets. The 'second-set' market is becoming an increasingly important factor, however, as is the replacement market for older receivers.

Radio sales were up some 6% last year, and continue at a high level with well over 700,000 units sold in 1957. Introduction of low-cost portable and clock radios, plus the utilization of transistors in place of vacuum tubes, has aided in sparking consumer demand. Sales of record players exceeded those of 1956 by some 34%.

Wiring and Lighting Market Promising

The majority of Canadian homes do not have adequate electrical wiring systems to support even a small portion of the household electrical appliances presently available. Besides older homes, many recently completed homes have wiring that does not allow the owner the full advantages of electrical living.

More than 150,000,000 light bulbs were used for electrical lighting in Canada in 1957. Office, store, and factory lighting all advanced during the year. Even casual observation of new buildings indicated the attention being given to better lighting. Offices with 100 foot-candles of general illumination are not uncommon.

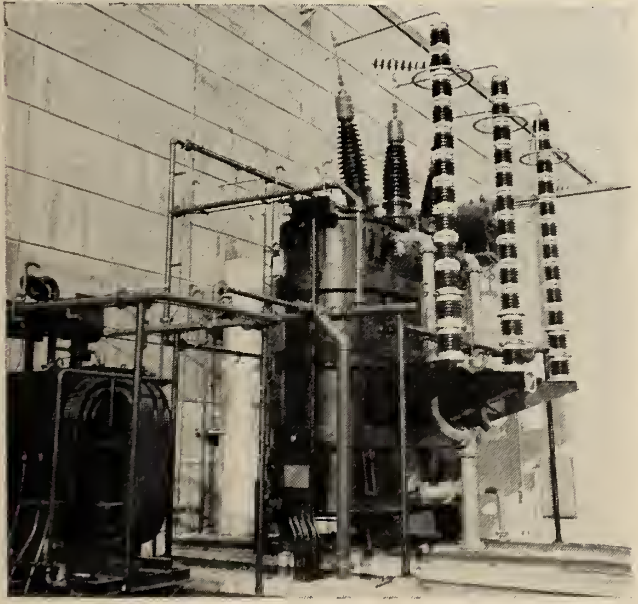
There was noticed during the past year an improvement in outdoor lighting and, in general, in floodlighting, street lighting, and electric signs. Sodium and mercury discharge lamps are now being used in floodlighting. Both fluorescent lamps of higher light output, and mercury lamps of various sizes and types, are more generally used in street lighting. Fluorescent lamps which can be flashed have contributed to new designs and greater attraction in electric signs.

In the home, there is a trend back to the use of more lighting fixtures and built-in lighting. Fluorescent lamps are coming into greater use in the home. Line fluorescent lamps provide a very satisfactory lighting effect for valances used in almost every room in the house.

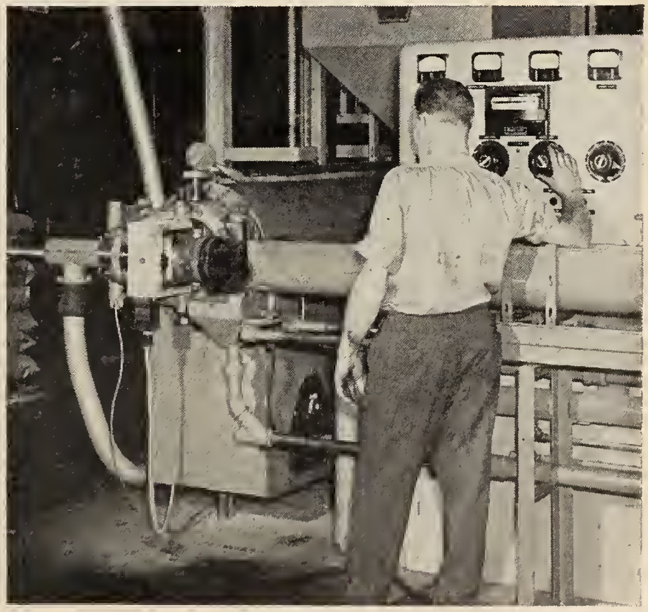
Production in Electronics

Developments in the field of electronics—and their application in communications, defence, and industry—are, and will continue to be, much in the public eye. Increasing applications for electronic equipment are constantly being found in defence work for radar; in aircraft and guided missiles; in the field of nuclear energy; in industry, for the greater use of automation and remote control; for communications, pipeline transporta-

A 400,000 kva. generator unit transformer at a hydro plant.



Extruder applying polyethylene coat over electric cable.



tion, railway signalling, and a host of other uses.

There is an evident trend toward diversification on the part of many electronics manufacturers. This is a result of over-capacity to produce within the industry. In the early 'fifties', the industry built up capacity beyond a level supportable by the nation's industrial and commercial economy. Defence requirements dropped from some $120 million in 1955/56 to about $80 million in 1957/58 and may drop even lower in 1958/59. The resulting competition means unsoundly depressed prices. Expanding commercial and industrial demand and an upturn in defence are needed to support present capacity.

The industry foresees less emphasis in the future on large quantities of individual defence equipments, and more on integrated and complicated systems combining early detection, plotting, communications, and automatic fire control. In commercial and industrial fields a more orderly expansion is expected based on automation, remote control, and electronic business devices.

Danger from Free Trade with U.K.

Leaders of the electrical manufacturing industry draw attention to suggestions advanced in recent months which, if implemented, could only weaken Canada's manufacturing base and thus result in long-term damage to the nation's economy. One such suggestion concerned the possibility of free trade with the United Kingdom. If this were implemented, they point out, it could only result in further access to our market for goods from a country with much lower wage rates than our own, without any attendant reciprocal advantages to this country.

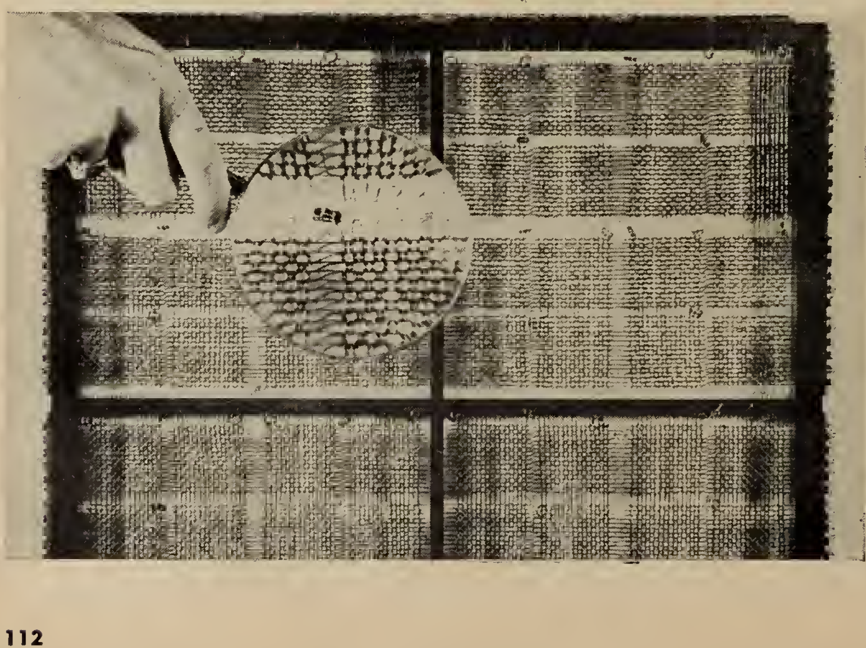
Despite the growth of secondary manufacturing since the war years, manufacturing's share of the Gross National Product in recent years has been a declining percentage. This is a reflection of the difficulties facing Canadian manufacturers in operating in a small market economy which offers relatively easy access to foreign producers. In this respect, there is current public emphasis on diverting Canadian purchases from the United States to the United Kingdom.

Public acceptance of this principle and desire to support it is already beginning to take effect. There is a danger here, it is emphasized, that Canadian purchases of domestically produced goods may also be affected, and that, in the enthusiasm for this program, orders for goods which should logically be placed in Canada would also be diverted to the U.K. Over the long-term, such an approach could only serve to weaken the country's manufacturing base and provide reduced job opportunities in the manufacturing industries which currently employ over 25 per cent of the labour force.

Industry Events in 1957

Production during the past year included many 60/100-thousand kva. generators and transformers for Canadian utilities; steel mill drive apparatus for Algoma Steel Corporation; power transformers for Brazil; ignition rectifier equipment for India; world's largest installation of magnetic amplifier control for Dofasco, Hamilton; and new combination plate and blooming mill for Algoma equipped with programmed digital automatic control. Outstanding developments included testing of new scatter-wave propagation for long-range multi-channel communication; new type pneumatic hoist airbrakes for mine-hoist equipment; the 'Litegard' photoelectric safety device to stop equipment if any object obstructs a guarding light beam. Other examples of new developments were the 'snow-white' area for filtering dust from the air supply to dwellings or factory rooms; development of polyethylene insulated (PIC) cables; and Canada's first oil-filled pipe cable system (piped power) at Edmonton.

Part of a core array, believed to be the largest single unit made, containing 16,384 magnetic cores. It is used for information storage in computing equipment.



An electro-mechanical computer for the nuclear energy field. The device uses data from nuclear reactor power to give information about the concentration of certain isotopes in the fuel rods.

Industry's Future Bright

Electrical manufacturers face 1958 with inventories in better balance than a year ago. Recent changes in interest rates, indications of general easing of credit, and increased federal action on housing have introduced a note of optimism that 1958 levels will be somewhat higher than those prevailing in the latter half of 1957. The effect of an expected significant increase in housing starts will be felt in the consumer durable market in the latter half of the year, and should be reflected in a lift in the overall economy.

Despite the 1957 decline in the

electrical manufacturing industry, a glance at past industry performance indicates that the long-term trend is up. Value of output in 1957 was well over double what it was a decade ago. Looking ahead, the industry expects to produce over twice as much equipment over the next decade as it has since its inception 65 years ago.

Our Electrical Future

The electrical manufacturing industry, looking ahead another twenty years, sees living standards 50 per cent higher than today. Well over 100 different appliances will be available. Heat-pumps will be in general use, and may consume more power than the entire country could supply in 1957. Dusting the house will be done with an electrostatic cleaning wand; bedrooms will be provided with laundro-closets to clean clothing quickly; dirt being removed by ultrasonic energy. Kitchen refrigeration will cool by current passed through the junction of two dissimilar metals.

Automation will combine food storage and cooking machines, allowing complete pre-selection of meals; 'rayescent' lighting panels no thicker than a pane of glass will be used electrically as a decoration. Transistors will bring widespread changes in the application of direct current in almost every field. Silicon diodes can already be built in package units to obtain large blocks of DC power.

A pre-designed alloy called 'Nivco', five times stronger than chrome steel, will improve the operation and efficiency of electrical apparatus to an extent never yet realized. Solventless silicone resins will revolutionize insulation for motor and generator coils.

An element known as 'Cypak', a control circuit with no moving parts or contacts, will perform basic functions of logical deduction, and send, receive, compare, collate, store, rearrange, and issue information needed to make a machine perform a predetermined series of operations automatically, with greater reliability and at no increase in cost. Many clerical offices in accounting, purchasing, production and order service departments will consist of a bank of computing machines operated by only a few skilled mechanics.

But new emphasis must first be placed on research and development. Young engineers must be kept interested in this field. The electrical industry must continue to adventure, promote and sell the idea of living better—electrically.

INDUSTRIAL MATERIALS

THE INDUSTRIAL materials considered here are used in the construction and other industries. They include asbestos, cement and concrete, clay and its products, and lumber.

ASBESTOS

CANADIAN PRODUCERS of asbestos shipped 1,061,419 tons in 1957 valued at $106.4 million, compared with 1,014,249 tons in 1956 valued at $99.86 million. These figures exclude the value of containers. The quantity increased 6.2% and value increased 6.5% over that of the previous year.

The largest producing area continued to be in the Eastern Townships of Quebec around Thetford Mines, Black Lake, East Broughton, and Danville. Ontario's production came from Munro Township. In Northern British Columbia the Cassiar Asbestos Corporation milled asbestos ore. Development work was done by Eastern Asbestos Co. Ltd. at Notre Dame de Sallette. Some discoveries were made in Newfoundland.

The Industry in 1956

In 1956, most recent year for which a full report is available, 23 establishments employed 7,065 persons whose earnings totalled $5.54 million. Cost of process supplies and containers at works was $12.33 million, gross selling value of products totalled $103.3 million, while net value of production amounted to $85.43 million. For the year 21.9 million tons of rock were mined and 13.74 million tons were milled. Values for shipments of various grades were as follows: crude No. 1 and No. 2, and other, $692,677; milled group 3 (spinning), $14.07 million; group 4 (shingle), $42.12 million; group 5 (paper), $13.2 million; group 6 (stucco), $12.68 million; group 7 (refuse), $16.67 million; group 8, $407,859. Exports for the year were valued at $163.64 million, while imports were valued at $5.38 million.

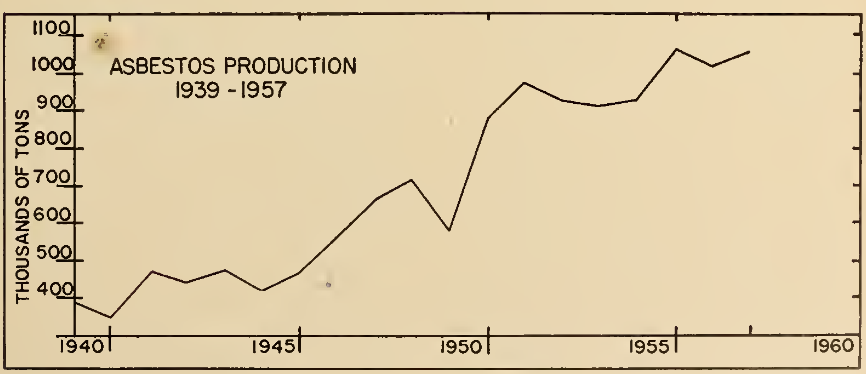
Asbestos has a variety of industrial uses. The longer-fibred spinning material is formed into textiles, packing and certain insulating and heat resisting friction materials. Other fibres are used in the asbestos cement industry for the production of pipe, shingle, tile, millboard, siding, roofing, etc., and for production of asbestos paper. The short-fibred material is used in protective coatings, plastics, lubricating greases and a number of specialized applications as an industrial filler. Canada produces some 62% of the world's supply, with Russia holding second place at 13½%.

CEMENT AND CONCRETE

PRODUCTION OF Portland cement in Canada during 1957 amounted to 6,056,038 tons valued at $93.76 million. Volume exceeded that of the previous year by 12%, while value exceeded that of 1956 by 12½%.

Cement production during the year, by provinces, in tons was as follows: British Columbia, 443,389; Alberta, 559,500; Saskatchewan 148,750; Manitoba, 424,000; Ontario, 2,182,200; Quebec, 2,079,524; New Brunswick, 161,000; and Newfoundland, 57,675.

During 1957, concrete products shipped (with comparative numbers shipped in 1956 for each item following in brackets) were as follows: concrete brick, 94.1 million (102.6 million); gravel concrete blocks, 78.6 million (84 million); cinder concrete blocks, 9.75 million (11.16 million); concrete blocks made from haydite, slag, etc., 17 million (12.1 million); concrete chimney blocks, 834,669 (862,193); cement drainpipe, sewers and water pipe and culvert tile, 453,226 (553,692); and ready mix



concrete, 4.966 cubic yards (4.987 cubic yards). These figures of production by principal manufacturers account for 85% of total Canadian output.

Industry Pattern

In 1955, latest year for which a full report has been published, the cement industry consisted of 12 plants with combined employment of 2,800 persons. Supplies and containers cost $11.5 million, while value of production at works amounted to $144.3 million. There were 29 kilns in all, with total capacity of 70,000 barrels per 24 hours. Apparent consumption (shipments plus imports, less exports) amounted to 27.16 million barrels.

For the same year, the concrete products industry included 592 establishments employing 9,780 persons; 4,457 of whom worked in Ontario; 3,051 in Quebec, 895 in Alberta; 743 in B.C.; 265 in Manitoba; 157 in Saskatchewan; and less than 70 each in the four Atlantic provinces. Wages and salaries totalled $30.7 million, materials used cost $63.3 million, and gross selling value of products totalled $133.83 million. During the year $15 million capital and repair expenditures were made.

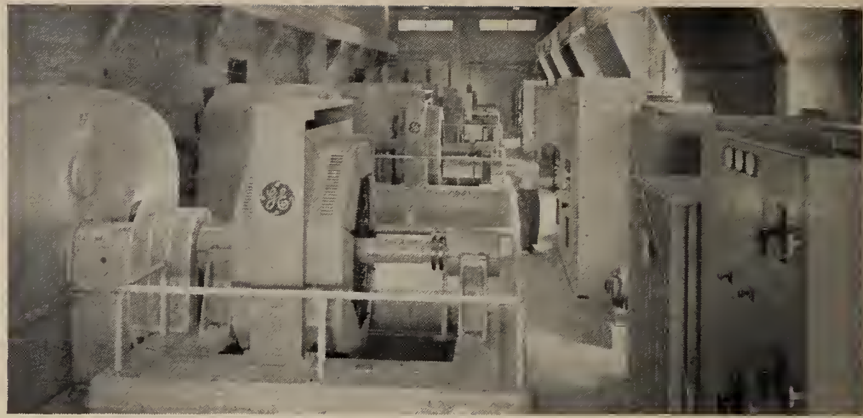
CLAY AND PRODUCTS

Clay products made from Canadian clays during 1957, valued at $34.7 million were 8.2% lower than the value of production for the previous year of building brick, sewer pipe and structural tile. Output of pottery and other clay products was higher than in 1956.

The industrial clays of Canada may be classed as common clays, stoneclays, fireclays, and china clays. Common clays are produced in all provinces. Stoneware clays are found in Saskatchewan, Manitoba and Nova Scotia. Fireclays are found in Saskatchewan and British Columbia, and to a lesser extent in Nova Scotia. China clay is not produced in Canada, but ball clay is produced in Saskatchewan. Bentonite is found in Manitoba and Alberta. Large quantities of fireclay and china clay are imported.

Production in 1956

The clay products industry is divided into two sections for statistical purposes: production from domestic clays, including building brick, structural drain, and roofing tile, stoneware, sewer pipe, pottery, and refractories came from 119 plants, in 1956, which employed 4,418 persons earning $14.8 million. Process supplies cost $1.12 million, gross selling value totalled $37.8 million and net value of production $30.45 million. Employment by provinces was: Ontario 2,203; Quebec, 796; Alberta, 471; British Columbia, 345; Nova Scotia, 227, Manitoba, 160; Saskatchewan, 125; New Brunswick, 103; and Newfoundland 8.



Motor room at the Canada Cement company's new Woodstock plant. The large synchronous motors power the raw and clinker mills. Annual production is 3,250,000 barrels.

Production from imported clays includes electrical porcelains, sanitary ware, sewer pipe, tableware, artware, floor and wall tile and fireclay blocks and shapes. Production in 1956 came from 37 establishments which employed 2,131 persons earning $7.5 million. Process supplies cost $6.22 million, gross selling value was $20.95 million and net value of production was $14.2 million. Employment by provinces was: Ontario, 1,200; Quebec, 744; Alberta and British Columbia, 162.

Four plants operated in the sand-lime brick industry in 1956—three in Ontario and one in Quebec. Employment totalled 135 persons earning $473,000, materials cost $366,258, while gross selling value totalled $1.3 million.

LUMBER

Production of lumber in Canada during 1957 at some 6.76 billion board feet showed a drop of 11½% from the previous year. This estimate was based on reports of production for the first nine months of the year. Production in the three prairie provinces showed a drop of 17%, British Columbia production was down 11.6%, while production in Ontario, Quebec, and Atlantic provinces was down 10.1%.

Canadian lumbermen are well aware that when export markets weaken, production immediately follows the same pattern. Ten years ago our export percentages were: United Kingdom, 41%; United States, 39%; other commonwealth countries, 12%; and other countries, 8%. Two years ago, in 1956, about one board foot out of every two produced was exported. That year 78% of our exports went to the United States, 12% went to the United Kingdom, 7% to other commonwealth countries, and 3% to all other countries.

But, during the past two years Canada's export markets have dropped by close to a billion board feet. Last year Canada lost between 17% and 23% of spruce and pine exports to the U.S., the U.K., and commonwealth countries. Exports of spruce and pine softwood species gained by some 50% to 65%. Hardwood exports decreased by about 17%.

Industry Statistics

In 1956, latest year for which full data on production were published, sawn lumber totalled 7.92 billion board feet, exceeding the 7 billion mark for the third year in succession and up 3.4% over the previous peak of 7.3 billion for 1953. Value of production at $541.56 million was up 6.7% over 1955. The industry includes production of shingles, box shooks, staves and headings, other sawn products and barking of pulpwood in plants other than pulpmills, woods operations are not included.

Of the 7,333 active sawmills reporting in 1955, there were 1,875 in British Columbia, 1,875 in Quebec, 1,039 in Ontario, 761 in Alberta, 643 in Nova Scotia, 549 in Newfoundland, 385 in New Brunswick, 303 in Saskatchewan, 121 in Manitoba, 69 in P.E.I., and 13 in Yukon and N.W.T. For the year 1,010 small mills were excluded as well as a few hundred small plants in other groups.

Employment totalled 58,586, 2.8% above the previous year. Salaries and wages paid amounted to $152.5 million. Cost of materials and supplies was $338.9 million. Production value at $644.5 million was up 12.6% compared with the previous year.

Production of softwoods at 7.546 billion feet was divided by species as follows: spruce 32%; Douglas Fir 31.2%; hemlock 13.2%; cedar 6.9%; white pine, 5.5%; jackpine 3.3%; balsam 3%; remaining 4% included tamarack, lodgepole pine, red pine, ponderosa and yellow cypress, in that order.

Production of hardwoods at 373,522 board feet was divided by species as follows: yellow birch, 36.8%; maple 25.6%; poplar 11.7%; basswood 6%; elm 5%; aspen 4.2%. Remaining 5½% was beech, oak, ash, alder, and cherry, in that order.

Principal sawn products for the year were as follows:

	billion feet	Value ($ million)
Lumber	6.92	541.56
Shingles	2.90	29.80
Ties	4.49	8.96
Box shooks	0.36	3.09
Laths	0.15	6.61
Hardwood sq.	0.01	1.15
Pickets, staves, headings	0.001	1.57

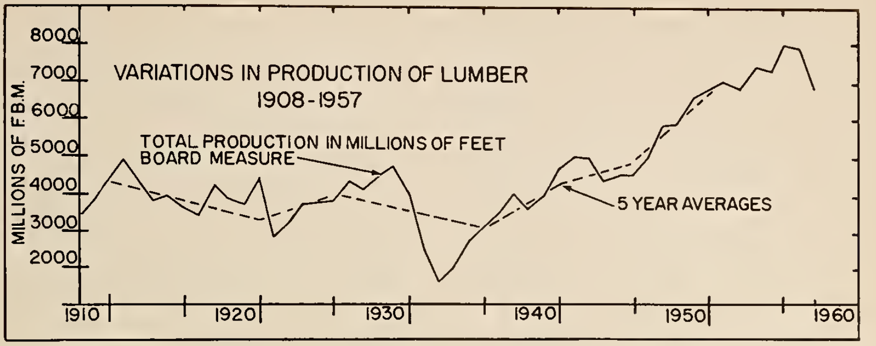
The mills range in size from the giant mills on the Pacific Coast, cutting up to half a million board feet per shift, to the small mills which only turn out a carload of lumber in ten days. The larger mills are concentrated around Vancouver, New Westminster, and the lower mainland of British Columbia as well as on Vancouver Island, along the Ottawa valley, Georgian Bay, Rainy River, and the Coast of New Brunswick.

C.L.A. Convention Hears Industry Problems

At the annual meeting of the Canadian Lumbermen's Association early in 1958, newly appointed secretary-manager, G. E. Bell, outlined some of the industry's major problems. Compared with Federal revenues of $200 million from agriculture, over half of which was spent on industry research, of the corresponding federal revenues from forest industries of $200 million only some $10 million were used for forestry research.

He called for a study of the problem of equalization of freight rates and for development of specialized freight cars for handling lumber. The latter, he said, promised savings of up to $40,000 yearly for larger lumber firms.

Pointing out that the United States had replaced Britain as Canada's main lumber export market, he urged greater attention be given to markets in other parts of the world, by meeting all trade delegations and maintaining close contact with Canadian trade officials.



Yet, he reminded delegates, domestic lumber sales amounting to half our total production, must not be taken for granted. The C.L.A. must act as a united body in promoting the use of lumber to combat the inroads made by substitutes. There was a tremendous potential in the home-improvement market for the lumber industry, he pointed out, variously estimated at between 500 and 650 millions annually. Of Canada's four-million dwelling units valued at some $25 billion, more than two and a half million were more than 22 years old and in need of repairs or alterations.

But the industry's trade journals, while not overlooking any of the above problems, have been emphasizing other almost equally urgent. Among them are:

(1) Properly designed mills and equipment, with better techniques and processes.

(2) Earlier replacement of equipment.

(3) Accuracy in production.

(4) Lumber to be sawn and graded for end use.

(5) A development program to find new and useful products.

(6) Better utilization of sawmill wastes by making slabs and edgings into chips.

(7) Assurance of fullest use before granting forest licenses.

Leaders Voice a Warning

Years of prosperity have blinded Canadian lumbermen to a realization of what is happening. Superimposed on obsolescence and demands for the repair of war destruction came the postwar era of industrial expansion and population growth. The world consumed lumber as fast as it could be produced.

But, in the belief that a change is coming, industry leaders are strongly warning the Canadian lumber trade to get ready for the competitive era ahead. Russia is a big potential competitor for lumber markets. It is not lack of Russian ability to compete that is protecting Canada's lumber export markets at the moment, but Russia's home needs for lumber to meet her vast building program and to service her rapid industrial expansion.

New Research Laboratory

One of the finest forestry laboratories of its kind in the world was formally opened at Petawawa, Ontario, on September 25 last year. It is the Forestry Experimental Station. This laboratory will provide facilities for scientific research carried out by the Forestry Branch, Department of Northern Affairs and Natural Resources. Furnished with the most modern equipment, its activities will include forest fire research, a tree breeding program and fundamental research.

B.C. Taxes on Timber Too High

In his report to the British Columbia government last year, Chief Justice Sloan found that the level of direct charges for government timber plus taxes assessed against loggers, owners and industry were dangerously high and directly opposed to the public interest.

At the Canadian Tax Foundation Conference, last September, at University of British Columbia, Ian Mahood, forest operation manager, McMillan and Bloedel Ltd., pointed out that Mr. Sloan's report had emphasized the high and discriminatory taxes that bleed off capital invested in private silviculture. Canadian capital created and saved from developing our resources was moving southward to start afresh in American forestry growth, he said. Unless we were prepared to get down to serious silviculture with our own choice species on land close to mills, we would face a declining forest economy and end up with high wood costs and no customers. The problem was the same across Canada.

THE CHEMICAL INDUSTRY

Canadian output of chemicals and allied products in 1957 was about five per cent above the value of production in the previous year, largely due to an increase in volume. Sales are estimated to have a value of some $1,200 million, but profits did not increase in proportion to the general rise because of higher labour and capital costs.

Capital expansion in 1957 was at a high rate, and preliminary estimates put the investment figure at about $135 million, or rather more than in 1956, from which several intended projects were carried over into the following year.

About 26 major chemical plants were completed in 1957, with a further thirty-odd under construction in addition to various expansion projects.

Only five outlets account for about 70 per cent of the demand for chemical products, of which some 27 per cent go to consumer industries, 15 percent to construction, and 6 per cent to agriculture. The increase in volume produced in 1957 was partly due to greater purchases by the construction industries and partly to the indigenous manufacture of materials that were previously imported.

Among the latter, a notable example is tetra-ethyl lead, of which about 90 per cent of imports were replaced by domestic production in the first half of 1957. Other chemicals made in Canada for the commercial market for the first time in 1957 included titanium dioxide, xanthates, synthetic silica-alumina cracking catalysts, and hydrogen fluoride.

Increases were noted in the production of sulphur from natural gas, ammonia, bulk oxygen (for metallurgical operations), sodium chlorate, caustic soda, and chlorine. The output of explosives and paints also showed an increase.

Organic Chemicals

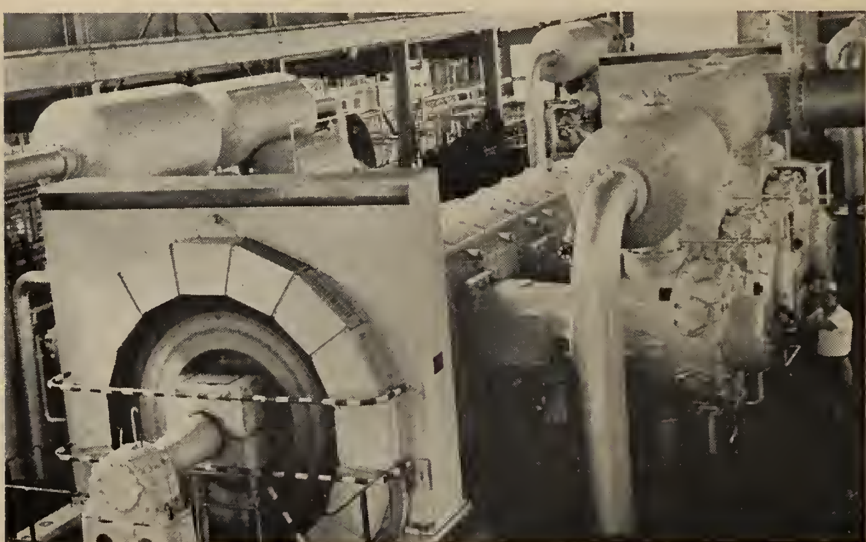
Several organic chemicals were among products for which production capacity was added during the year, notably: ethylene and other olefines, butadiene and benzene; coal tar chemicals; phenol and acetone; ethanolamines; nylon intermediates; polyester, polyvinyl chloride, nylon, and other resins, their fibres and derivatives; and synthetic rubbers.

Whereas expansion in 1956 was largely for the industrial inorganic chemicals, current developments are aimed more at increasing organic petrochemical capacity.

Imports and Exports

Imports of chemical and allied products in 1956 amounted to some $200 million, compared with exports at $228 million. Imports in 1957 are estimated to be of the order of $295 million, but exports may have been somewhat less than the 1956 figure, thus showing a larger adverse import/export balance. Nearly 87 per cent of chemical imports into Canada come from the United States, which take about half Canada's exports in this field.

Largest in Canada, this compressor at the Millhaven, Ont., ammonia plant of Canadian Industries Limited weighs 250 tons and has a 6000-h.p. motor. There are two such multi-stage compressors in the plant.



In 1954 the total value of chemical and allied products manufactured in the world was about $50,000 million, of which Canada, ranking ninth in the list of producers, accounted only for about two per cent.

Among the fields in which Canadian exports increased in 1957 compared with 1956 were fertilizers and synthetic resins.

Expansion Across Canada

Major expansions in the chemical industry, completed or under way in 1957, were mainly in British Columbia, Ontario, and Quebec. Some of the developments that took place are indicated in the following list.

British Columbia — Major expansion of facilities for producing sodium chlorate, chlorine, and caustic soda, which will reduce the need to import these materials from the United States. Petrochemicals and sulphur capacity also increased.

Alberta — An addition was made to capacity for caustic soda, polyethylene, and resins.

Saskatchewan — Sulphuric acid production was increased to keep pace with the demands of expanding uranium processing.

Ontario — Industrial chemical expansion included chlorine, carbon tetrachloride, caustic soda, soda ash, sulphuric acid, sulphates, phosphoric acid and phosphates, hydrogen peroxide, oxygen, actylene, argon, ammonia, and water-treatment chemicals. In the organic chemical field facilities were developed for: epoxy and phenolic resins; ethylene glycol, ethanolamines, polystyrene foam; Orlon and nylon intermediates; cellulose; various plastics; detergents. Other fields included: fertilizers; pesticides; adhesives and asphaltic coatings; paint and varnish; explosives; various petrochemicals; and pharmaceuticals.

Quebec — Expansion was largely in the fields of industrial and organic chemicals. Among the former were: anhydrous hydrogen fluoride; acetylene and oxygen; caustic soda and chlorine; nitric acid; sulphuric acid and explosives. In the organic chemical field were: phthalic anhydride; polyethylene resins; epoxy resins; vinyl-coated fabrics; detergent alkylates; synthetic fluid cracking catalyst; rubber chemicals; and pharmaceuticals.

Pattern of the Industry

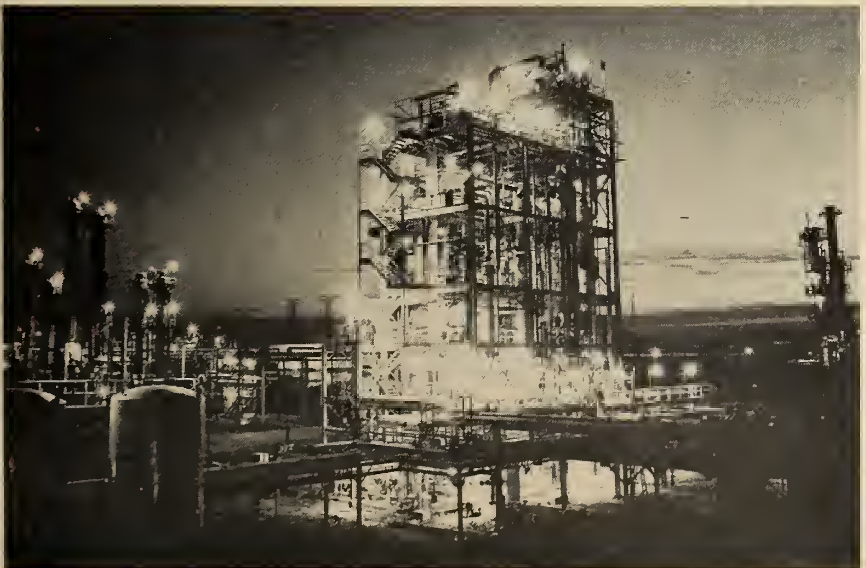
The accompanying table shows how

A general view of the Shawinigan East chlorine—caustic soda plant of Shawinigan Chemicals Limited. It is expected that production will start early in 1958.

Manufacturing Statistics 1956—Chemicals and Allied Products Group

	Establishments No.	*Selling value of factory shipments* $
Acids, alkalies and salts	48	193,541,164
Miscellaneous chemical products	259	226,427,832
Fertilizers	45	83,399,218
Medicinal and Pharmaceutical preparations	212	122,592,220
Paints, varnishes and lacquers	126	126,312,114
Soaps, washing compounds and cleaning preparations	142	109,384,798
Toilet preparations	91	41,324,564
Vegetable oils	12	42,239,497
Primary plastics	25	82,738,552
Inks	33	15,902,813
Polishes and dressings	45	20,847,347
Coal tar distillations	11	13,221,192
Gases, compressed	53	20,972,581
Adhesives	29	12,329,512
Totals	1,131	1,111,233,404

Night view of oxide reaction unit where ethylene is converted to ethylene oxide at the Montreal East plant of Carbide Chemicals Company, Division of Union Carbide Canada Limited.



Scene at new Orlon acrylic fibre plant of Du Pont of Canada, Maitland, Ont.

the chemical and allied products industry is broken down for statistical purposes, and gives the number of establishments and selling value of factory shipments for the year 1956, the last period for which complete figures are available.

The 'miscellaneous chemical products' category includes such items as explosives, hardwood distillation, insecticides, matches, dry colours, and so on.

Tariffs

Among the difficulties facing the Canadian chemical industry, with its high rate of capital investment and relatively high labour costs, is the intensively competitive market in which it has to compete with, in particular, the United States and with Germany and Japan. In some fields these problems are aggravated by existing unfavourable tariff regulations.

In general, tariff rates on most chemicals are considered to be reasonably satisfactory, but there are notable exceptions, such as the synthetic resins. Tariff rates on synthetic resins imported into Canada range from zero to 7½ per cent, whereas corresponding tariffs on products going into the United States vary between 35 per cent and 40 per cent. Furthermore, the U.S. enjoys the advantage of lower production costs, related to a much larger home market.

At the request of the Minister of Finance, the Tariff Board is to start hearings on a review of tariff schedules for items in the chemical field, and revisions have recently been made to include synthetic resins and ethylene glycol.

Members of the industry are preparing recommendations for the consideration of the Board.

It is anticipated that, although there may be no drastic change in policy on tariffs in, say, the next five years, nevertheless the Government attitude towards this question may well be revised.

Future Expansion

The progress of the chemical industry is largely linked with the development of the major Canadian natural resource industries, such as agriculture, mining and metal refining, lumber, pulp and paper, and petroleum and natural gas — all of which are large markets for chemical products.

The expansion of these industries, which is a long-term probability, the development of the country by such projects as the St. Lawrence Seaway, and the anticipated increase in population are all factors which have to be taken into account in predicting the future progress of the chemical industry. New applications will probably be found for existing materials, and an enlarged domestic market may find applications for new products in the chemical field.

The Gordon Commission, in its findings, considered that chemicals would represent some 10 per cent of the gross national product by 1980, as compared with 5.1 per cent in 1955 and only 2.4 per cent in 1928. In terms of overall growth, this would mean that the chemical volume in 1980 would be about five times that in 1955.

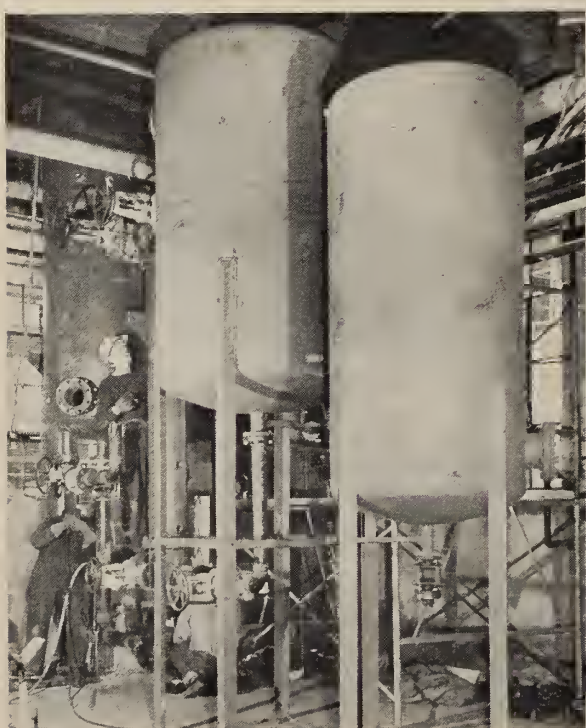
For the immediate future it is expected that some parts of the industry will be operating below full capacity, for example, the chlorine and alkali industry, which will feel the effect of the general slow-down by its industrial consumers. On the other hand, the sulphuric acid industry was due to expand by some 70 per cent over the three-year period 1956 to 1958, largely stimulated by the increase in uranium ore leaching.

Despite this possibility of a period of over-capacity, it seems likely that the factors of increased population, advances in technology, and development of natural resources will lead to the slack being taken up in the chemical industry in the next two or three years.

Research

The amount spent by Canadian chemical companies on research is only about a fifth, on a *per capita* basis, of that spent in the United States, where about 3 to 3½ per cent of sales dollars go to research and development. In 1955, the fourteen major U.S. companies spent some $200 million in this direction, whereas Canadian expenditure was $8 million.

Although purely Canadian research is relatively small, there were important additions to chemical research facilities during 1957, and it is estimated that the industry accounts for almost one quarter of investment in such assets by Canadian manufacturers.



Partial view of new equipment being installed for the production of rubber chemicals at the Ville LaSalle plant of Monsanto Canada Limited.

Rubber

Canada's Supply of synthetic rubber is entirely produced at Sarnia, Ontario, by Polymer Corporation of Canada, Ltd., while the nation's supply of natural rubber is all imported. Polymer Corporation, with employment of about 1,600 persons, produced some 132,100 long tons of synthetic rubber in 1957, an increase of 10% over the previous year. Production of reclaimed rubber at 5,025 long tons was up 6½% over 1956. Synthetic production is more than 80% in the form of Buna-S, followed by butyl, neoprene, Buna-N, and other types in that order.

Total consumption of rubber in 1956, by types, in millions of pounds, was: natural, 96.4; synthetic, 108.4; and reclaimed, 37.3. Canadian industry used more synthetic than natural rubber in 1956 for the first time since the end of World War II. Consumption of synthetic rose to a record of nearly 46% of all rubber used.

The Rubber Products Industry

In 1956, factory shipments by the rubber products industry were valued at $355.6 million, or 10% higher than the previous year. Employment stood at 21,913 persons. Materials used in manufacture cost $160.7 million, 17% higher than in 1955. Production was practically confined to Ontario and Quebec, with 82% and 18% of factory shipments respectively.

Tires and tubes accounted for 52% of the value of shipments. Tires numbered 8.6 million valued at $175.6 million. Footwear ranked second in importance and 16.5 million pairs were shipped, valued at $37.9 million. The balance of the output consisted of rubber heels and soles, belting and hose, medical and druggists supplies, mechanical rubber goods, etc., valued at $133 million. Composition by main types was: for tires and tubes, 41% natural, 44% synthetic and 14½% reclaimed; for footwear 40% natural, 46% synthetic and 14½% reclaimed; and for wire and cable, 88% synthetic and 12% natural.

Pulpwood at a mill in Corner Brook, Newfoundland

PULP AND PAPER

The total value of pulp and paper produced in 1957 was slightly lower than the record valued at $1.4 billion established in 1956. Yet tonnage of wood pulp produced at 10,176,700 tons was the second highest in history, slightly below 1956 but well above 1955. Newsprint production at 6,396,000 tons was less than one per cent under the 6,469,000 tons produced the previous year. Pulp exports at 2,232,200 tons were some 7% below exports in 1956, while exports of newsprint at 5,901,500 tons fell about 1% below 1956. Paperboard production declined about 4% while wrapping paper production fell by the same percentage, though export of wrapping paper rose sharply. Output of fine papers was up about 2 per cent.

Measure of the Industry

Though a complete government report of the industry for the past year is not yet published, the full up-to-date statistics are maintained by the Canadian Pulp and Paper Association. Its Research Institute is recognized as one of the chief centres of world knowledge on wood, pulp and paper.

Including 95,000 woods workers cutting wood for sales to mills, close to 270,000 seasonal workers cut and move the pulpwood harvest. The 75,000 pulp and paper people permanently employed in the mills, woods, and services are amongst the highest paid workers in industry.

In all, pulp and paper creates employment for some 335,000 workers. Woods employment runs counter to the normal seasonal pattern, providing work in late autumn and winter when work elsewhere is at low-ebb, thus helping to stabilize overall employment. Of the industry's annual wage bill of some $460 million, about 60% goes to the mill workers and the remainder to woods workers.

There are 80 pulp and paper companies operating 130 mills in eight provinces. Their output is one quarter greater than that of all the Scandinavian countries combined. Canada has 26 companies making newsprint. They operate 146 newsprint machines in 42 mills with a combined capacity exceeding six million tons yearly.

Next to the newsprint mills, the paperboard plants are the largest paper producers in the industry. They turn out 900,000 tons per year and give permanent employment to some 5,000 Canadians. Value of their output amounts to $125 million annually. Some paperboard is made of wood pulp and some, wholly or partly, from straw or repulped paper. The wrapping-paper industry with 13 mills creates some $55 million of new wealth yearly and including seasonal workers employs 16,000 persons.

The fine paper industry consists of 15 mills operated by 9 companies which produce annually more than 250,000 tons of fine papers having a value of some $80 million. These mills provide employment for about 28,000 persons, 8,000 of whom work in the mills.

The Canadian industry has an annual output of some 10½ to 11 million tons including 2½ million tons for sale; 6½ million tons of newsprint and 1.8 million tons of other papers, paperboard, building papers and board.

More than four fifths of the total output moves abroad. Some 92% of newsprint and 90% of the pulp produced for sale goes to foreign markets. Almost a third of the U.S. wood fibre requirements comes from Canada. Of the total, 45% comes from Quebec; 26% from Ontario; 13% from British Columbia; and 16% from the other five producing provinces. Pulp and paper accounts for about 5% of Canada's gross national product.

In newsprint Canada has a production four times that of any other country and provides more than half of the world's supply. Every hour, night and day, Canada's newsprint mills produce the equivalent of a

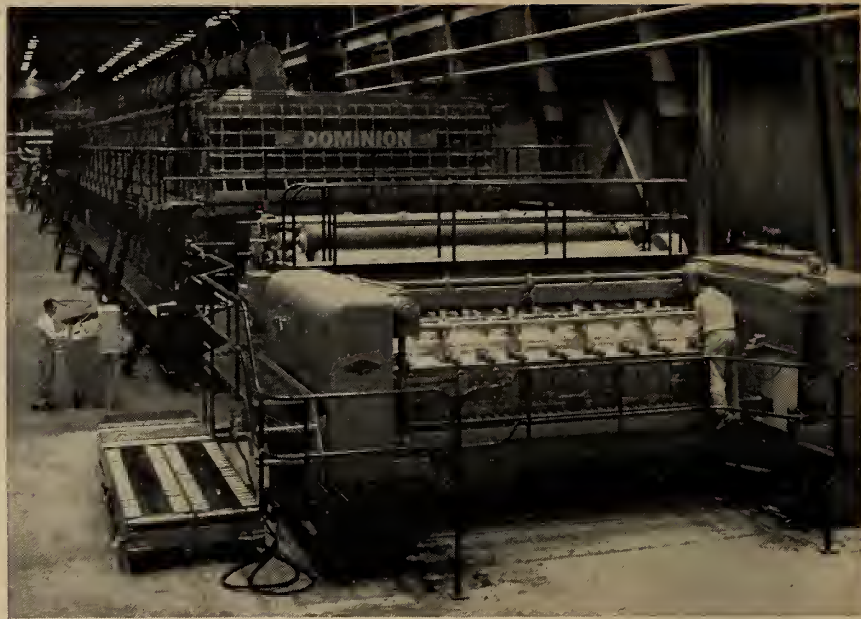
6,000-mile five-foot ribbon of paper, enough to stretch from Toronto to Baghdad. With exports of $708 million newsprint is Canada's largest item in Canada's export trade, accounting for 15% of all exports.

Based on the replacement value of the mills, the industry represents an investment of $45,000 for each mill employee.

CPPA President Reviews Industry Affairs

Addressing the Canadian Pulp and Paper Association convention at Montreal in January 1958, Association president, R. M. Fowler, told delegates that the industry was facing problems it had not faced for more than 15 years. Demand had fallen below available supply; mills were operating at the close of the year on a five-day week or even less; woods operations were 25 per cent below a year ago; competition within the industry and from other world producers was increasing. The long record of industrial peace had been shattered by a long and costly strike in the British Columbia mills.

Canadian newsprint mills produced the same total number of tons in 1957 as in 1956, he pointed out. But the fixed number of tons was nearly 104% of rated capacity in 1956, only 95% of capacity in 1957, and might be about 85% of 1958 capacity. The immediate future looked bleak, with the prospect of more curtailments, more difficult marketing problems, and more industrial unrest to come.



Pulp drier at the North Western Pulp and Power mill, Hinton, Alta., starts with a slush pulp of about 99/1 water/fibre and reduces it to 95%–100% fibre. The totally-enclosed machine has 66 driers, reportedly the largest number in one unit. The dry end is equipped with automatic baling and weighing machinery.

"For a decade we have seen—and indeed enjoyed—the greatest boom in history. A full belly maketh the heart glad. But a full belly requires time for digestion", he declared. "Some day North America must pause to digest the immense capital investment expansion that still continues even after eleven years of unprecedented industrial growth."

Even if normal growth had occurred in total world demand last year, we would still have had too rapid an expansion of productive capacity. This, he observed, was the classic dilemma of a capitalistic society: the sum total of individual decisions to expand capacity exceeded the normal growth of demand, and produced over-capacity. But we must rely on the forces of the free market to produce their own corrections, and on the same individual power and right of decision to solve the problems they have created.

Principal Statistics for the Pulp and Paper Industry*

	Production 1957	Production 1956	Exports 1957	Exports 1956
Gross value of output	$1.4 billion	$1.4 billion	$1 billion	$1,045 million
	tons	tons	tons	tons
Total wood pulp	10,176,707	10,542,300	2,232,185	2,388,484
Dissolving & Spec. chem.	341,411	411,194	291,523	344,551
Bleached sulphite paper grades	583,300	674,765	384,736	443,530
Unbleached sulphite	1,754,162	1,834,146	297,036	379,893
Bleached sulphate	882,970	812,534	716,353	670,281
Unbleached sulphate	775,391	801,285	256,020	225,385
Other chemical	244,823	234,022	41,311	45,628
Groundwood	5,516,713	5,679,983	237,697	268,491
Newsprint	6,396,114	6,468,815	5,901,527	5,971,692
Containerboard	455,495	474,071	57,402	56,555
Boxboard	390,063	412,348	22,262	25,274
Total paperboard	846,008	886,419	79,664	81,829
Fine paper	252,086	248,005	16,270	16.733
Coated paper	29,450	29,167	1,202	1,006
Other printing paper	80,925	92,620	54,590	61,764
Special papers	124,800	122,171	5,218	6,437
Wrapping paper	269,177	280,591	18,836	14,309
Bldg. papers and boards	272,000	281,000	20,000	22,500

There are some slight duplications in the foregoing figures. Some paper board and wrapping paper is used by the mills for packaging. Coated paper covers a tonnage that undergoes a further processing after it leaves the paper machine and thus is also included under other grades. Total wood pulp production includes screenings, but excludes defibrated and exploded pulp. In addition to wood pulp, the industry uses annually in the manufacture of paper some 470,000 tons of stock including waste paper, straw, rags, cotton linters, flax, jute, rope, and other fibres.

* Preliminary 1957 figures provided by the Canadian Pulp and Paper Association.

A Return to Normality

Questioning that the present situation should be described as a temporary recession, Mr. Fowler expressed belief that in reality it was a return to normality, in an economy of abundance, after nineteen years of abnormality caused by war and its aftermath. Specifically the newsprint industry had created an excess of capacity to look after sudden surges of demand, as it ought to be able to do. Believing the future of newsprint demand was a bright one he expressed doubt that most of his listeners would live to see a return, except for brief intervals, to the full capacity operations we had enjoyed for the last decade. One could regard excess capacity as a man regards an ulcer and learn to live with it. Or one could look at this new situation as a challenge and rise to meet it, and have excitement doing so.

Four Prescriptions Proposed

On the assumption we would choose the latter, more imaginative course, there were four specific things that should be done. Most of them were in our own hands, he said. First, we should look to our productive efficiency. We must learn to produce our pulp and paper products as efficiently as and more economically than, any other producers in the world. We must be in the forefront of technological progress.

Secondly, we had a job to do in co-operation with our labour leaders. More had to be done to bring the industry's economic facts to their attention, and to try to enlist their skills and influence in the strengthening of the competitive position of the industry in world markets. This was a partnership, in which the partners had the same objectives; the creation of the maximum number of jobs.

Thirdly, there was a role for government to play in collaboration with the industry, he suggested. In a country as dependent as Canada is on export trade, national commercial policies could profoundly influence the success or failure of Canadian competition in world markets. Here, again, there was no conflict of interests. If the industry makes a dollar the federal government gets 47 cents, and provinces and municipalities also gain.

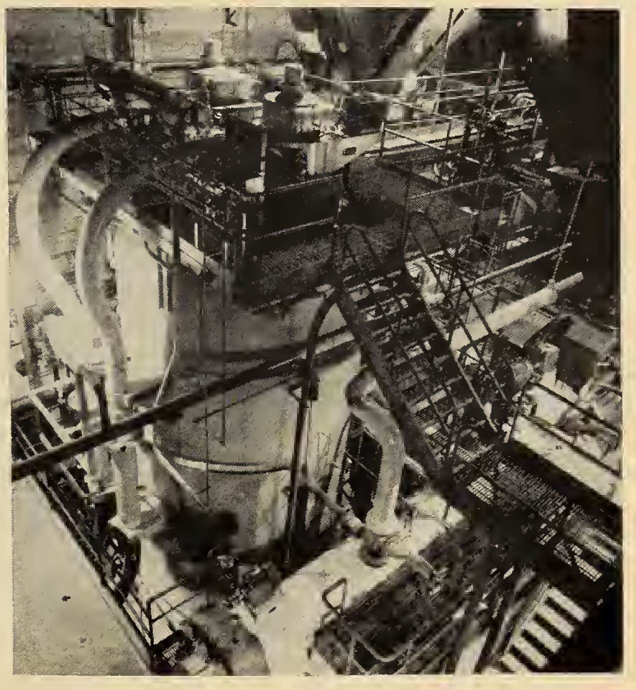
1957 a Year of Permanent Change

Fourthly and finally, each inindividual company must look to its merchandizing. Merchandizing skills had had little practice over the past fifteen or twenty years and our weapons had grown a little rusty. The merchandizing decisions of even the smallest company could strengthen or weaken the fabric of the whole industry.

Concluding, the speaker declared he refused to believe today's economic situation was one of distress or anything even remotely resembling calamity. The long term economic demand for pulp and paper was high and would undoubtedly increase greatly. But, looking back, we would see that 1957 was a year of great and permanent change in the conditions of our enterprise.

We had been rudely shown something we had refused to believe before: that the western world is in a race for intellectual leadership when we had not even realized there was a race. In the complacency of what we thought was an assured technicological lead, we had confused high living standards with intellectual stature.

The new bleached sulphate pulp mill of B.C. Forest Products Limited at Crofton, B.C., started test runs in 1957 and was to come into full production early in 1958.



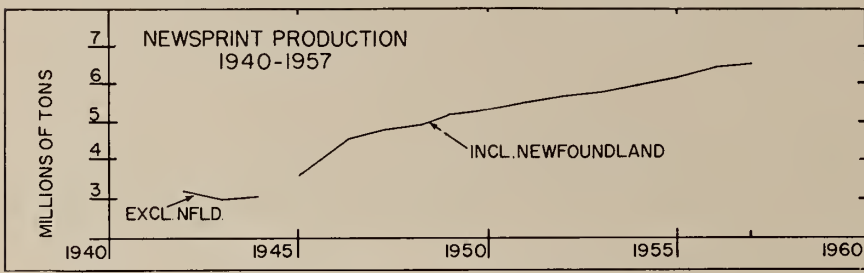
Top of continuous digester, showing chip feeders and high pressure inlets, at North Western Pulp and Power mill, Hinton, Alberta.

Woodfibre plant of Alaska Pine & Cellulose Limited, B.C.

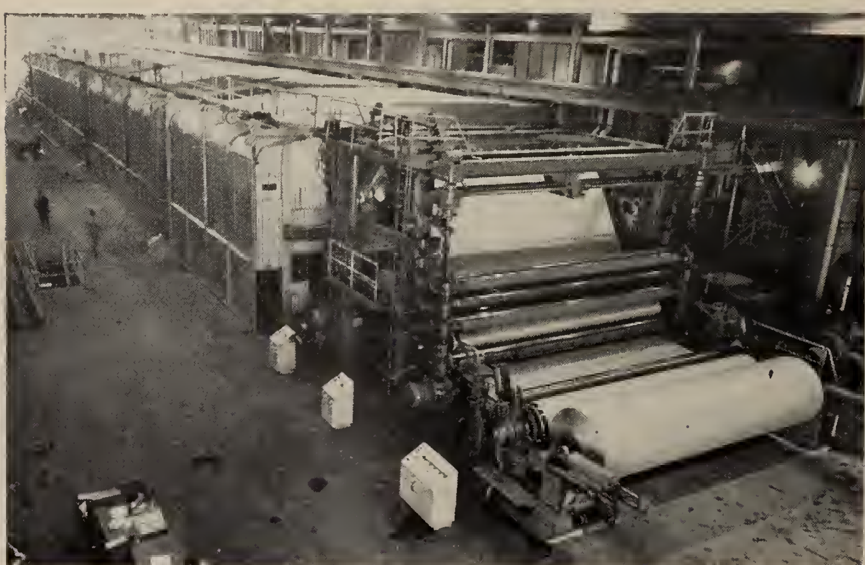
This could be an extravagant and dangerous mistake.

New Peaks in 1980

By contrast, a survey for the Gordon Economic Commission, recently released, predicts Canada's forest industries will reach new peaks by 1980. Production of all forestry products would reach a value of $4 billion by that time, an increase of 120 per cent. An average annual outlay of between $300 million and $400 million would be required. Employment in forestry industries might rise by a third to 370,000 workers, though this would represent a drop from 5.3% to about 3.8% of the total Canadian labour forces of 9,637,000 in 1980. Canada's pulp and paper production might more than double, to reach a total of 21.9 million tons annually by 1980. Most of the tonnage increase would be due to a big jump in newsprint demand to 12.5 million tons a year from the 6 million tons produced in 1954. The demand from overseas markets for newsprint would far exceed the rise in U.S. requirements.



Paper plant of the Canada Paper Company, at Windsor Mills, Que., where expansion was under way during 1957. Below is the new board and paper machine in the La Tuque mill of Canadian International Paper Company, part of a $20,000,000 expansion. Machine covers raise automatically opposite any paper break.



Additions to Capacity in 1957-58

The end of 1957 saw an approach to the close of an unprecedented era of expansion in the Canadian pulp and paper industry. Many major projects had come to fruition and were either in operation or nearing completion during 1958. In Canada the ten-year period 1946-1956 witnessed some 1.6 million tons of added capacity, four-fifths of it by improvements to existing equipment. The year 1956 saw a further 513,000 tons of capacity added, while during the year 1957 another 394,000 tons of capacity were added to the total — 36 per cent addition in twelve years. Of the capacity added during 1956 and 1957 new plants and new machines, costing in all more than half a billion dollars, have added two thirds of the total and improvements have added the other third. A further ten or more projects have been abandoned or deferred.

In the past year the North Western mill at Hinton, Alberta, reached completion, as well as expansion programs at Elk Falls and Alberni in British Columbia. The current year will see completion of Alaska Pine, Great Lakes, and Abitibi programs, and startup of the Crofton mill in British Columbia and of the Thurso mill in Quebec. The Powell River modernization and the McMillan-Bloedel expansion in British Columbia are well on the way to completion, while three Consolidated Paper expansion programs, two in Quebec and one in Ontario, costing some $27 million, are in progress. Renewals and expansion for B.C. Forest Products at Crofton will soon reach production stage.

This era of expansion is now ending, and the pulp and paper industry has entered a period of cautious adjustment, with emphasis on cost production, modernization, improvement and speedup, growth of converting operations, and increased regard for a higher degree of utilization and materials research.

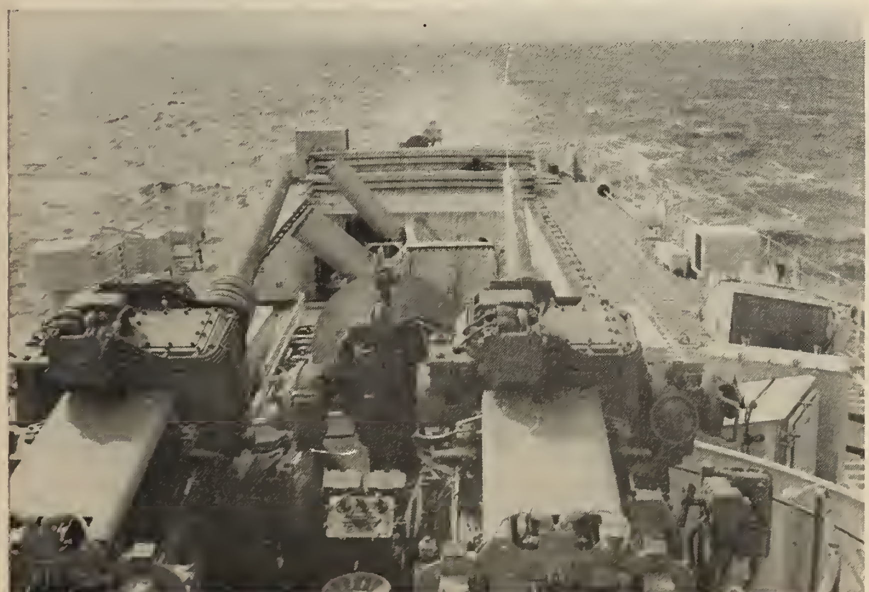
NATIONAL DEFENCE AND DEFENCE CONSTRUCTION

THE 1957-58 DEFENCE Budget for the fiscal year ending March 31/1958 called for an expenditure of $1,789,964,000, a reduction of some $52.16 million from the appropriation for the previous year. It also included $63.8 million from special accounts. In addition, $3.3 million incurred for aircrew training, to be recovered, were deducted from the gross estimate. The estimates included proposed expenditures, by services, in millions of dollars, as follows: Navy, $309; Army, $478.8; Air, $844.76; Defence Research Board, $64.8; mutual aid, $21.56; and other, $70.96.

Strength of the Forces

At 31 December, 1956, the strength of Canada's Regular Forces stood at 117,177 officers and other ranks, including officer cadets and apprentices. Of this total 19,005 were enlisted in the Navy, 47,632 in the Army, and 50,540 in the Air Force. Total strength of the Reserve Forces was 53,551, of whom 5,739 were on the Navy active list; 42,212 were in the Militia; and 1,958 were in the R.C.A.F. Auxiliary. Officer candidates in training at the same date totalled 6,774; of which 1,053 were in training for Navy, 3,330 for Army, and 2,391 for R.C.A.F. The civilian strength listed some 53,000 personnel of whom 4,745 were non-continuing or casual employees.

Above is an 'Argus' (CL-28) submarine hunter designed and built in Canada for the R.C.A.F. The Navy's role in anti-submarine warfare is exemplified by the view, below, of the quarterdeck of the new destroyer escort HMCS *Fraser*.



Defence Estimates for 1957-58

Each service prepares its estimates, gets them approved by Parliament and does much of its own engineering and design. Purchase of supplies and equipment are made through the Department of Defence Production, while contracts for construction and for engineering supervision thereof are awarded by Defence Construction (1951) Ltd., a crown company.

The value of all Canadian production of equipment for the services, as well as the value of construction of airfields, barracks and other facilities are covered elsewhere in this Review under the reports of the various Canadian industries and under construction statistics, as well as the labour forces involved. To avoid duplication they need not be recorded hereunder, except for the purpose of showing the values of the end products going to the various services.

Division of Appropriations by Categories and by Services

National Defence appropriations for the fiscal year 1957/58 were divided by major categories as follows: military personnel costs, $516.8 million; operations and maintenance, $605.7 million; procurement of equipment, $497.9 million; construction, $132 million; contributions to Infrastructure and NATO Budgets, $18.3 million; and Mid-Canada Line, $19.2 million; a total of $1,790 million.

After deductions for charges to special accounts, of $67.1 million, resulting total of budgetary amounted to $1,722.8 million.

Personnel Costs

A breakdown of military personnel costs of $516.8 million noted above showed: pay and allowances, $422.7 million; travelling and removal, $45.9 million; medical and dental services, $5.09 million; medical and dental supplies, $2.14 million; laundry and dry cleaning, $1.9 million.

Operations and Maintenance Costs

A breakdown of the $605.7 million noted above for operations and maintenance was: Navy, $95.9 million; Army, $133 million; Air Force, $282.9 million; Defence Research, $24.3 million; and other, $69.5 million. About a third of the total provided for repair and upkeep of equipment, and of buildings and works, rental of buildings, and utility services. Pension funds accounted for a little more than a further third. The remainder included $40.5 million for gasoline, fuel oil and lubricants, $18.8 million for fuels for heating and cooking, and lesser amounts for barracks and hospital stores, freight, postage, and so forth.

Equipment Costs

A breakdown of the $497.9 million noted above for major equipment procurement was divided among the services as follows: Navy, $116.5 million; Army, $63.8 million; Air Force, $275.8 million; D.R.B., $38 million and other, $3.8 million. The total excludes initial equipment costs in connection with the mid-Canada Radar Line which is dealt with elsewhere. Army equipment purchases were mostly financed from special account funds.

Construction

The construction program for 1957/58 amounting to $128.6 million was divided by services, as follows: Navy, $10.35 million; Army, $68.05 million; Air, $50.25 million. Provision for barracks, mess halls, hangars, depots, etc. was $84.9 million; married quarters and schools, $26.1 million; airdrome development, $4.78 million; minor projects, $8.3 million; purchase of property, $4.55 million. Expenditures directly related to the building of the mid-Canada line, including installation of equipment amounted to some $47 million in 1955/56 and $124 million in 1956/57. Expenditure to complete it in 1957/58 was estimated at $19.2 million, with an additional $18.2 million to be provided for the first year's operation and maintenance by contract.

D.R.B. and Mutual Aid

Added to the above were appropriations for the Defence Research Board of $24.2 million for research and $40.6 million for development. Provision of $130 million for mutual aid included NATO aircrew training, $28.6 million; transfers of equipment from service stocks and from direct production, $83.1 million; and Infrastructure and NATO budgets, $18.3 million.

Steam for aircraft catapults is stored in accumulators below the flight deck of the carrier HMCS *Bonaventure*.

The 20,000-ton aircraft carrier, HMCS *Bonaventure*, showing angled flight deck.

The Navy in 1957

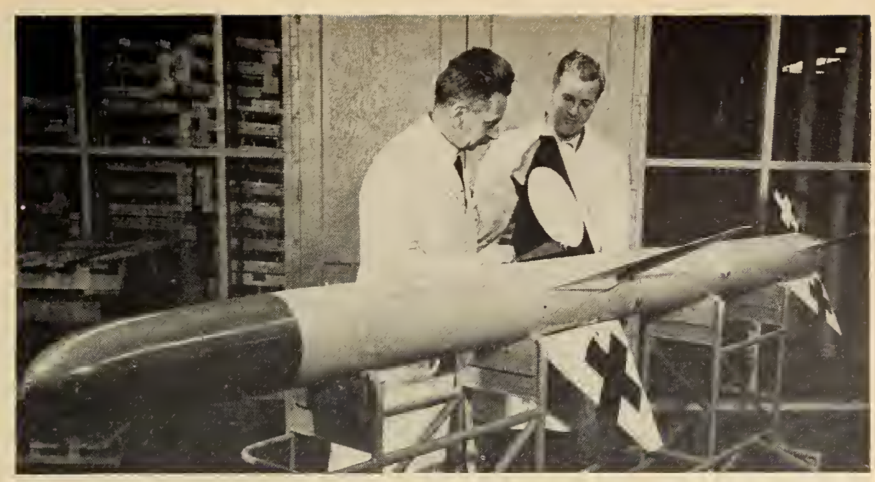
During 1957 the Royal Canadian Navy concentrated its main efforts on creation of a fleet capable of meeting the threat of missile-armed submarines. Major additions to the fleet were the new aircraft carrier, H.M.C.S. *Bonaventure*, a modern mobile base for anti-submarine aircraft; three new destroyer escorts, the *Skeena*, *Fraser*, and *Margaree*, and four frigates returned to service after modernization and addition of new weapons.

In the air, one naval air squadron was re-armed with anti-sub Trackers, with a second on the way to being equipped with this new and powerful aircraft. Two fighter squadrons were re-armed with all-weather 'Banshee' jets, and Tracker and Banshee squadrons were embarked on the *Bonaventure* in September. Training and experiments were continued in the use of helicopters for anti-sub warfare. Coastal defences were strengthened with five *Bay* class minesweepers equipped with latest sweeping equipment.

At year-end the Navy's combat ships in commission numbered 45, excluding five vessels undergoing refit and three R.N. submarines under R.N. operational control. To man the ships and aircraft and provide shore support the R.C.N. had a regular force at year-end of 19,558 officers, men and Wrens.

During the year, under Mutual Aid, five *Bangor* class coastal escorts were transferred to Turkey. The aircraft carrier *Magnificent* was returned to the Royal Navy, while the Arctic patrol ship *Labrador*, after co-òperating with U.S. Coast Guard vessels in establishing an escape route for deep draught ships through the Arctic was paid off for refit before transfer to the Dept. of Transport.

Climax to the year's seagoing activities came in September with the NATO fall exercises, in which eight Canadian destroyers took part, operating with naval units of five other NATO nations in the North Atlantic, Bay of Biscay, and Baltic approaches. Later six of them visited Germany and five Scandinavian countries.



The Sparrow II air-to-air guided missile is being developed for the R.C.A.F.

R.C.A.F. Accomplishments in 1957

The year 1957 saw the Royal Canadian Air Force add materially to its operational effectiveness. During the year the Mid Canada early warning line was placed on an operational footing. Built and operated by Canada, it stretches some 2,500 miles westward from the Labrador coast—a valuable addition to the American Air Defence System.

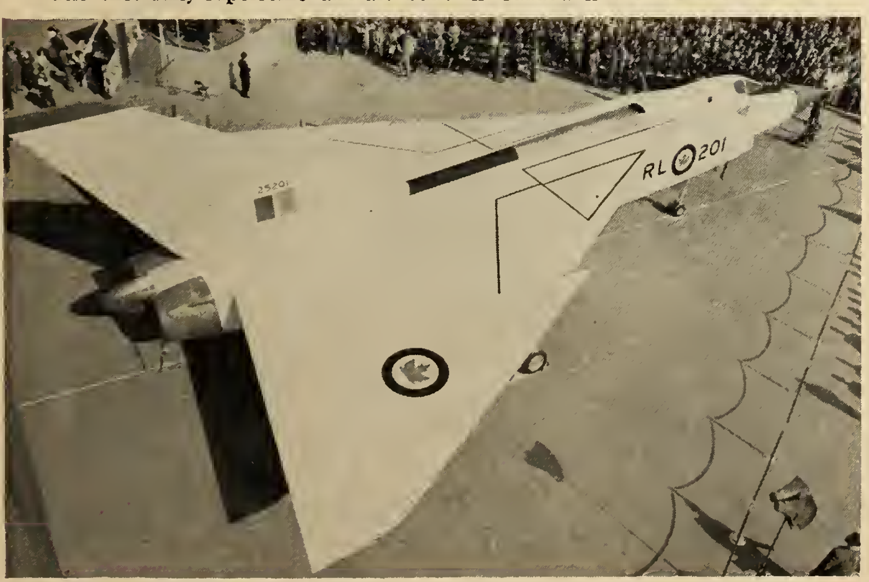
In September the R.C.A.F. took delivery of the first of its big 'Argus' sub-killer aircraft from Canadair of Montreal. Destined for operational service with Maritime Air Command, the Argus is the largest aircraft ever built in Canada and the most potent aircraft of its type yet produced. Early in October the supersonic all-weather 'Arrow' jet interceptor, designed and built by Avro Aircraft of Malton was unveiled. The big interceptor, crammed with the latest in electronic equipment, and designed to carry guided air-to-air missiles, is the first supersonic aircraft made in Canada.

Canadian-developed navigational devices, the R-Theta computer and the positioning and homing indicator, continued in production, as well as work on a number of projects for safety equipment, improved parachutes and other aids to safer flying.

In Europe, 1957 saw completion of the transfer of four CF-100 all-weather interceptor squadrons to Canada's Air Division in Europe. Together with the Division's eight F-86 Sabre day-fighter squadrons they are providing our air Division's combat forces with an around-the-clock combat capability.

Announcement was made of joint Canadian-U.S. mutual aid contribution of 53 Canadian-built CF-100 interceptors to Belgium. The first 14 were ferried across the Atlantic in December. A small group of Belgian ground technicians were given training by R.C.A.F.'s Air Division Overseas to facilitate servicing these craft.

The first fully-supersonic aircraft built in Canada is the CF-105 Arrow.



In addition 10 pilots and observers from the Belgian Air Force were given CF-100 flight training at Cold Lake, Alberta. During the year the first of 360 West German aircrew trainees also arrived in Canada for pilot training.

During the year R.C.A.F.'s Air Transport Command carried more than 50,000 passengers and airlifted more than 14 million pounds of cargo from Indo China, the Middle East, Europe and throughout Canada. A.T.C. squadrons continued to provide air transport in support of the United Nations' Emergency Force in the Middle East, as well as carrying out several trips to Saigon on behalf of the Canadian Indo-China Truce Commission.

The year also saw the completion of No. 408 Squadron's nine-year-old Shoran aerial survey program in Northern Canada. A rise in R.C.A.F. search and rescue operations activity occurred, with a total of 8,200 aircraft hours flown on air searches and rescue missions; 25% above the previous year. Nos. 404 and 405 Squadrons, Maritime Air Command, based at Greenwood, N.S., operated their Lockheed 'Neptune' aircraft from both sides of the Atlantic during such training schemes as 'Sea Spray' 'Sea Watch' and 'Fend-Off'.

Last summer Air Marshal Slemon was named Deputy Commander-in-Chief of the North American Air Defence Command (NORAD) with headquarters at Colorado Springs. NORAD will provide integrated planning and operational wartime control of the aerial defences of North America and will contribute to a more effective air defence system for the whole continent. Air Defence Command's nine squadrons, whose re-equipping with Mark V CF-100's was completed in

1957, participated during the year with the U.S.A.F., in a series of cross-border training exercises.

Army Adjust to New Conditions of Warfare

A comparison of army equipment of today with that in use towards the end of World War II shows clearly the substantial improvements that have been made in virtually every arm of the service. 'Centurion' tanks have replaced 'Shermans'. A complete new range of combat vehicles has been produced, and new field, medium and anti-aircraft artillery.

The 'Heller' anti-tank weapon and the 'Iroquois' flame thrower, a new sub-machine gun, mine detector, and counter-mortar radar detection equipment, as well as improved communications equipment, are now in service. Production of the new FN-C1 rifle began to come into service in 1957. The Army has designed a lightweight tracked vehicle capable of operating in deep loose snow, in water and over rough timbered terrain. It was built by Canadair, Ltd.

In addition to the 'Flying Truck' project, developments to enhance the mobility of land forces has included work on traction devices, over-snow tractors and navigational aids. The tracked carrier project continues, aimed at developing a multi-purpose tracked chassis for armour, artillery, infantry and other uses.

Many changes were seen in 1957 concerned with the adjustments to new conditions of warfare expected under the influence of nuclear weapons and rocket propulsion. Soldiers have been concerned with the new era of tactics and strategy for some years, but last year the army practised the new tactics with simulated nuclear devices at Camp Gagetown; more than 100,000 regular army troops fought a mock nuclear war, and thousands of rounds of live ammunition were fired during the exercises without incident.

Canadian-built Sabre VI fighters for the West German Air Force.

In Germany, the 2nd Canadian Infantry Brigade Group completed two years of intensive training as part of the NATO ground forces. On this side of the Atlantic for the first time a tactical formation of several hundred Canadian troops took part in exercises in the presence of an actual nuclear weapon in Nevada, while R.C.A. gunners trained with the U.S. army at Fort Bliss, Texas and with the British Army in the U.K. to keep abreast of latest developments in the guided missile field.

As a result of this training and experimentation, reorganization has been taking place. A third armoured regiment was raised in January and two battalions of the Regiment of Canadian Infantry Division were disbanded. At year end the Headquarters of the 1st Canadian Infantry Division at Petawawa were disbanded. The army will henceforth be organized into four balanced brigade groups, three in Canada and one in Germany.

During their first year in Egypt, Canadian troops scored an impressive record with UNEF. Responsible for second-line transport for the entire force, Canada's No. 56 Transport Company, RCASC, logged almost 2 million miles, most of it over sandy desert roads. An RCAMC hospital in Egypt treated or cared for thousands of sick or injured soldiers. No. 56 Signal Squadron R.C.S. strung 500 miles of telephone cable, and handled 18,000 messages monthly. At year end No. 56 Canadian Reconnaissance Squadron R.C.A.C. was patrolling the Israeli-Eygptian border in 'Ferret' scout cars from the Gaza Strip to Gulf of Aqaba, while the 1st Middle East Detachment, R.C.E., removed or blew up an uncounted number of mines in sand-covered minefields.

Three 'RAT' articulated tracked vehicles under development for the Army.

Defence Research Board

In addition to its support of and co-operation with the armed services, D.R.B. carries out work in several less directly related fields. The Board's co-operation with Universities of Toronto, McGill, and Laval on radar, aerophysics, and medical research has been notably productive. D.R.B. conducts considerable personnel research. Medical, psychological, and environmental problems are increasing in scope and complexity, demanding more and more effort in these fields.

The Board is also concerned with geophysical and Arctic research, particularly as these apply to winter warfare. Its aim is to provide the forces with information on oceanography, the atmosphere, climatology, magnetism, meteorology, hydrology, and navigation. The emphasis remains on the arctic aspects of these sciences.

Emphasis on the Board's studies on civil defence is on problems arising from the threat of attack with thermonuclear weapons. Investigations include development of techniques for predicting the probability of fall-out and for verifying the extent. A number of questions relating to evacuation of cities have been studied.

DEFENCE CONSTRUCTION

Defence Construction (1951) Ltd. was established in November 1950 for the purpose of administering the National Defence construction program. In addition, DCL has been administering the Capital Assistance Program, Colombo Plan Projects, some of the defence projects financed by the U.S. government, and most recently the construction of the Natural Gas Pipe Line (Northern Ontario Section).

The dollar volume of all defence and non-defence projects administered by DCL in the past seven years amounted to about $1.2 billion dollars. Value of defence construction work put in place during this period was equivalent to 50% of all Federal expenditures on new construction projects, excluding housing and capital works projects financed by government-owned enterprises like the Film Board, T.C.A., etc. At year-end DCL had under its administration over 900 contracts with a value of $460 million. These contracts cover work in Canada, France, India, Pakistan, and Ceylon and will cost over $90 million to complete—$69 million in Canada and $21 million overseas. In the fiscal year 1958/9 expenditures on current and new projects for which DCL is responsible will amount to $135 million.

Translated into physical terms this defence construction program means thousands of buildings and structures, either erected or still under construction in some 300 locations spreading from Halifax to Vancouver and from Whitehorse and Frobisher Bay to the U.S. border. The program includes roads, bridges, railways, runways, dams, wharfs, radar stations, laboratories, warehouses, barrack blocks, housing units and many other buildings and structures.

Supervision

To supervise a construction programs of this volume requires a unique supervisory force, which now includes 92 fully qualified engineers and a large number of technicians. Its operations are controlled through six Branch Offices located in Halifax, Montreal, Toronto, Winnipeg, Edmonton and Vancouver, and over 80 'on site' field offices which are being set up and closed down with the start and completion of work. R.C.A.F. projects in Europe are handled by DCL office in Paris.

Most supervision is done by DCL personnel, but policy on supervision calls for substantial aid from the professions. When there is reason to believe that a project having special engineering requirements can best be supervised by a consultant, either the designer or an engineer who specializes in this type of work, then a consultant is retained.

At year-end DCL had under administration nearly 400 contracts for architectural and engineering services for defence projects. Of the work represented by these contracts some $2.6 million remain to be expended. Of this amount over $400,000 is for supervision by engineers.

A typical main station of the Mid-Canada Line during construction.

The Year 1957 in Review

1957 was another busy year for DCL. Expenditures on defence contracts alone amounted to $108 million, compared with $98 million in 1954, $105 million in 1955, and the record high $160 million in 1956. However, new contract awards at $58 million were considerably less than in previous years, and consequently DCL entered the year 1958 with a carry-over of work more modest than in previous years. It is expected that in 1958 the situation will be reversed: expenditures on defence projects will go down but a considerable volume of new contract awards will greatly increase the carry-over for 1959.

Major projects under way last year included completion of the Mid-Canada Line, secondly the work on the Northern Ontario Section of the Natural Gas Pipe Line, and thirdly the further progress on Colombo Plan projects.

The Mid-Canada Line, now completed, was the challenge of the north to contractors and transportation men. For two years this was DCL's major project, differing in problems which it created from anything undertaken before. Only those who took part in this project know of the tremendous effort which was necessary to bring men and materials on to the construction sites, and the amount of planning it took to have them there at the right time. Canadians had never before participated on such a wide scale in a combined operation of air-lift and tractor train transportation of such magnitudes. Including electronic equipment and transportation, the project involved over $200 million.

Under an agreement with the Northern Ontario Pipe Line Crown Corporation, DCL is providing engineering liaison for the Northern Ontario Section of the Line, calling tenders, recommending contract awards, and providing general field supervision of construction work.

The Northern Ontario Section eastward from the Manitoba-Ontario border was divided into two portions.

The first portion, 311 miles long from the Border to Lakehead, was subdivided into four spreads, and four contracting firms were working simultaneously one on each spread. They met their target of bringing pipe to the Lakehead at the beginning of this year. At present work is proceeding on the second portion, 365 miles between the Lakehead and Kapuskasing. It is divided into 5 spreads and the five contractors are working on clearing the right-of-way.

Contracts for construction work and supply of materials for the Crown project amount to about $100 million. The work involves placing of about 215,000 tons of 30-in. diameter steel line pipe. The quantity of dynamite used in making right-of-way and ditch in the first section only, 311 miles from the Border to Lakehead, is estimated at 4,500,000 lb.

Progress on Colombo Plan Projects

Since 1953 DCL has assisted the International Technical Co-operation Division of the Department of Trade and Commerce by assuming the responsibility of the negotiating and administration of engineering and construction contracts connected with the Canadian Colombo Plan Construction Program. The total value of the eleven projects located in Pakistan, India and Ceylon reached the $186 million mark in 1957, of which $78 million represents Canadian participation.

During the past year, three of the eleven projects were completed and handed over to the recipient countries. These include the 350 metric ton per day cement plant at Daud Khel, Pakistan, the 10,000 h.p. hydro-electric plant at Mayurakshi, in India, and the fish refrigeration plant at Colombo, Ceylon, capable of processing 300 tons of fish per week. During the coming year, a 10,000 kw. steam plant will be completed in East Pakistan and the balance of a 52 mile transmission line in Ceylon is expected to be completed.

In west Pakistan good progress was made on the 160,000 kw. hydro-electric power and irrigation project at Warsak. A colony of nearly 300 Canadians have been established at the site of the work in the tribal area of the North West Frontier, not far from the Khyber Pass. Here, there was a labour force of 7,557 (138 Canadians, 19 Europeans, and 7,400 Pakistanis).

Also in West Pakistan a substantial start had been made at Shadiwal, where 12,000 kw. are being developed to operate tube wells to reclaim water-logged land and simultaneously use the pumped out water for irrigation in other areas. The Dacca Chittagong transmission line and the Goalpara steam power plant, both in East Pakistan, and the Kundah hydro-electric power project in India were well under way.

All of these projects have been designed and equipment and material specified by Canadian engineering companies and construction firms.

In so far as possible, material and equipment of Canadian manufacture is specified and supplied to these projects, with the result that in some instances 90% of the equipment and services is of Canadian origin.

The search and rescue homing device 'SARAH' has a beacon effective up to 75 miles and voice unit for close range.

Forecast for 1958

In 1958 DCL will probably award new defence work close to a value of $100 million, compared with awards in 1957 amounting to $58 million. It is expected that defence works put in place in 1958 will have a value of $65 million, compared with some $100 million placed in 1957. In addition there will be an expenditure of some $58 million on the pipeline and some $12-14 million on the other non-defence program—the Colombo Plan. This would involve administering a total defence and non-defence expenditure of $135 million in 1958, if estimating proves reasonably accurate

On the major projects planned for the near future should be mentioned the RCAF Station at Summerside, P.E.I. where it is expected work will be started before summer on the construction of hangars and on facilities estimated to cost $8 million. A similar program is planned for Greenwood, N.S. at an estimated cost of $7 million.

Canada's Defence Policy

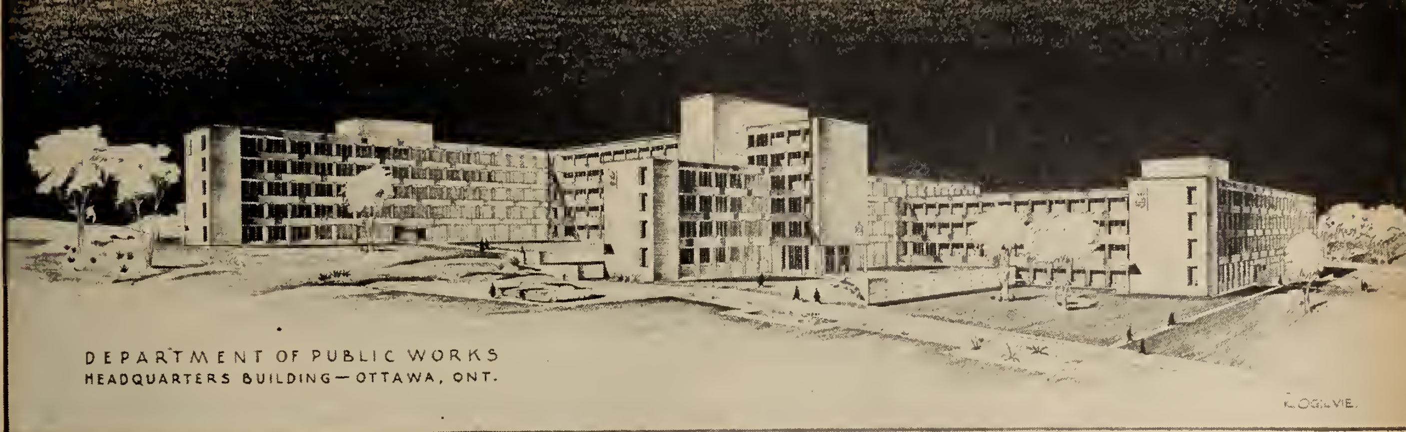
Addressing the House of Commons on December 5, 1957, the Hon G. R. Pearkes, V.C., Minister of National Defence, explained Canada's defence policy and commitments. It was 'to provide for the security of Canada, and the Government believed the best way to achieve that aim was through membership in NATO . . . The best way to prevent war is to make it clear to a potential enemy that war would be so disastrous it must not be contemplated.' Summing up Canada's contributions of 12 squadrons of interceptor aircraft, forty naval fighting ships, and a Canadian infantry brigade of 5,000 men, he explained to the members that if we were drawn into a major conflict, the situation would be quite different from those of 1914 and 1939.

One of the first and vital battles, he warned, might well be for survival within our own boundaries.

Knowledge that the U.S.S.R. have many long-range submarines capable of launching missiles far from our shores at targets well inland emphasized the importance of the anti-sub role of our navy. Because the initiative will always rest with the enemy the navy must be operationally ready before any war begins.

The officer appointed as Commander-in-Chief, North American Air Defence, was made responsible to both governments for air defence of North America, and to report directly to the U.S. joint chiefs of staff and the Canadian chiefs of staff committee. All plans must be approved by both and, when necessary, by both governments.

'Our military advisers believed a third world war would commence with a sudden ferocious thermonuclear attack from several directions' stated Mr. Pearkes. This initial period, when the fight for survival was paramount, would be likely to decide the eventual outcome. It was important that the forces required be trained, equipped and in position, he warned. There would be no time for mobilization. That was why we must continue to give top priority to our regular forces. Only if we survive that initial stage would it be possible to raise and train additional forces.



A contract has been awarded for the construction of a headquarters building in Ottawa for the Department of Public Works.

GOVERNMENT WORKS

FEDERAL • PROVINCIAL • MUNICIPAL

THE ANNUAL survey of proposed capital investment in construction for 1957, made by the Department of Trade and Commerce in the fall of 1956, disclosed intentions for 1957 adding up to a value of some $2½ billion by all three levels of government. Expenditures at Federal level were estimated as follows: by government-owned enterprises, $302.8 million; housing, $35.5 million; government departments, $322.5 million; a total of $660.8 million.

Expenditures at Provincial level had been forecast as follows: by government enterprises, $474.0 million; by institutions, $55.6 million; and by government departments, $541 million; a total of $1,070.6 million. Expenditures at municipal level had been forecast as follows; by government enterprises, $162.4 million; by institutions, $198.5 million; and by government departments $404.7 million; a total of $765.6 million.

Intentions in 1957

In the annual report of the Construction Industry 1956-1957, intentions for 1957 had been recorded for total construction in each province, for both public and private account. Though not shown separately in these tabulations, expenditures by provinces or regions for highways, bridges and fences, and for schools, hospitals, other institutions and waterworks and sewage systems at all government levels which are mainly built with public funds, can be found. (Table 1.)

Table 1 Intentions by Regions for Certain Types of Public Construction in 1957

Millions of Dollars

Type	Maritimes	Quebec	Ontario	Prairies	B.C.	Canada
Schools..........	$11.8	$50.9	$96.0	$55.8	$34.0	$248.5
Hospitals........	10.8	37.4	53.6	35.1	27.0	163.9
Other Institutions	15.1	18.0	24.2	12.2	3.1	72.6
Sub-Total........	37.7	106.3	173.8	103'1	64.1	485.0
Water and Sewers	7.1	64.5	110.0	54.1	21.2	256.9
Roads, Bridges...	67.9	162.7	340.2	182.2	99.4	852.4
Total...........	112.7	333.5	624.0	339.4	184.7	1,594.3

Per capita expenditures on these categories of public construction are above the national average for British Columbia, the prairie provinces and Ontario, in that order, but below the national average in Quebec and the maritime provinces.

Federal Department of Public Works

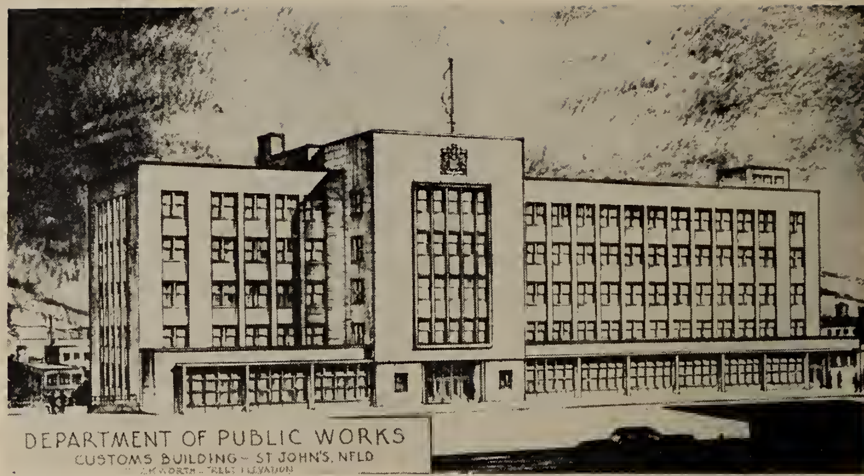
During the fiscal years 1956/57 construction and repairs were made to 302 wharves, breakwaters and other harbour facilities, of which 232 were completed. In addition, 1339 smaller projects were undertaken. Work was under way for National Defence at Dartmouth and Esquimalt. Dredging was carried out in 304 locations involving removal of some 7½ million yards of material.

Contracts for construction, alterations and improvements were awarded during the year. The extensive program of building in Ottawa was continued. An expanded program of fairly large building was also in progress across Canada.

Total expenditure during the fiscal year 1956/57 totalled $189.7 million, divided as follows: public buildings, $88.3 million; Trans Canada Highway $36.1 million; harbour and river works, $27.5 million; dredging $6.7 million; engineering and building for other departments, $26.3 million; other outlays, $4.8 million.

Construction intentions by the Federal Department of Public Works for fiscal year 1957/58 totalled some $322.5 millions, of which $196.6 million was for building and $125.5 million was for engineering construction. A statement released at the end of 1957 announced a total of 1426 different types of projects would cost some $100 million to complete. The Department had also undertaken 48 building projects for other federal departments on which there remained $14 million to be spent.

Under way at year end were: harbours and rivers, 861 projects on which $16.2 million was still to be spent, development engineering projects on roads and structures in Parks and N.W.T., including Trans Canada Highway totalled 19, on which $6.7 million remained to be spent. Building numbering 87 in various parts of Canada would cost some $75 million to complete.



Proposed building for the Customs and Excise Divisions, Department of National Revenue, in St. John's, Newfoundland, for which a contract has been awarded.

Provincial and Municipal Construction in 1957/58

Work accomplished in the fiscal year 1957/58 by various provinces is noted elsewhere in this issue for provincial roads and bridges under the section dealing with construction. In Table I are given trade and commerce forecasts of 1957 expenditures on roads and streets and on waterworks and sewerage projects by regions, performed by all three levels of government.

Though no information is available from various cities or municipalities, and while Provincial Public Works Departments generally have failed to supply detailed reports, work on public buildings by the Department of Public Works of Ontario is probably typical. Ontario accounts for more than a third of all the public building construction done at provincial level in Canada.

Ontario Public Works 1957/58

For the fiscal year 1956/57 expenditures on public works by Ontario on capital account totalled some $30 million. During the year 1957/58 it has exceeded $40 million; while for 1958/59 the Department estimates there will be more work done than in the year 1957/58.

During the year just ended several administrative units were provided for the Ontario Provincial Police. A building on Fleet Street in Toronto was renovated for a Headquarters and a crime detection laboratory. New district headquarters were built at Port Arthur, Barrie, Niagara Falls and Timmins. Detachment buildings were completed or under way at 13 stations across the province. Registry offices were built at North Bay and Port Arthur and houses for personnel at 16 other points. Many garages were also built.

For the Highways Department, garages and other buildings were completed at seven points. Divisional garages were completed at Huntsville, Kenora, Ottawa, and others started at Kingston, Bancroft, and McFarlane Lake. Garages of various sizes were under construction at eight places and additions were under way at Downsview. Other work was progressing at Hearst, Marathon, and Ear Falls.

For Ontario medical hospitals much work was carried out to provide bed accommodation, with other ancillary factors. The 1200 bed hospital at North Bay was opened last October. Hospital buildings are well advanced for the 500 bed hospital at Kingston. Two new continued treatment pavilions were nearing completion at Brockville, one for male and one for female patients. Additions to the Chest Diseases Division at Woodstock are well advanced, while buildings for a pasteurization plant, a central power plant and a trades building were under way. An extension to the Criminally Insane Building at the

One of the bridges built by the Ministry of Public Works, Quebec, crosses the St. Francois River between Grantham West and Wendover, Drummond County.

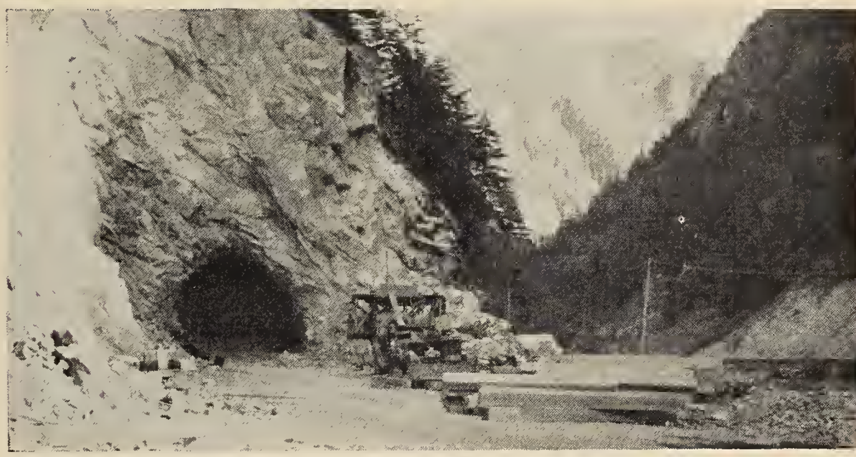
Ontario Hospital, Penetanguishene, was opened in November. New additions were under way at Whitby, and for Ontario hospitals at six other cities. Buildings were extended and renovated at Sarnia, Toronto and Hamilton. A complete new hospital unit for retarded children is planned in the Chatham district.

Regional buildings for the Public Works Department were added to at London, Port Arthur, Mimico, Orillia, and Sault Ste. Marie. For the Department of Lands and Forests new buildings and renovations were under way at Maple, Pembroke, Plevna, Uxbridge, Forest, and Fort Frances, as well as for a new Mining Recorder's office at Kirkland Lake. Six cottages were under construction at Elliott Lake for mine inspectors.

For reform institutions, a training school for incorrigible boys was completed at Guelph, as well as a similar centre for incorrigible girls at Galt. The new reformatory at Millbrook was opened last June. Work on a new training centre for reformable women at Brampton had re-commenced.

In the field of education, work was completed for the new Lakehead college of Arts, Science and Technology, while the old State Street School at Ottawa was renovated to accommodate the Eastern Ontario School of Technology. The teachers College at Hamilton was opened and work was under way for another at London. Three Toronto buildings were being renovated for the Institute of Trades. At the Ontario Agricultural College in Guelph an extensive program of work was under way. Other building renovation and construction was completed or partly completed at Ridgetown, and Vineland.

Major renovations to services and property at the Legislative and Departmental Buildings at Toronto is constant, with much work required each year to maintain, alter, and improve existing buildings.



Pembina (Man.) overpass, and tunnel in the Fraser Canyon, Trans Canada Highway.

Deerhome mental hospital at Red Deer, Alberta.

P.F.R.A.

The Prairie Farm Rehabilitation Administration, or P.F.R.A. as it is generally referred to, was set up under the Prairie Farm Rehabilitation Act of 1935 during the severe drought and depression of the thirties. The Act was amended in 1937 to increase its scope and authority. Administered through the Federal Dept. of Agriculture, its head office is in Regina, with regional offices in Kamloops and Winnipeg, and 18 district offices in the four western provinces.

Its two primary functions are water development, and land utilization within the 105 million acre area under its supervision. The grand total of Federal outlays to a year ago amounted to some $122 million. This financial assistance was divided to provinces as follows; Manitoba $9.38 million; Saskatchewan, $54.8 million; Alberta $54.5 million; and British Columbia, $3.37 million.

Water Development

Under the water development program 43,600 dugouts, 6,718 stockwatering dams, and 53,500 individual irrigation projects were built up to March 31, 1957, at a cost of $34.7 million. Eleven major irrigation and acres, were also built jointly with the provinces concerned at a cost to the Federal Treasury of $63.3 million.

There are some 2.7 million acres of reclamation projects at present serving 930,000 acres, which can ultimately be extended to serve 2,703,000 acres within the so-called 'drought area' of western Canada, for which there are water supplies available in the rivers, and so situated that they can be economically irrigated. Today Alberta has some 783,000 acres under irrigation, while in Saskatchewan there are about 200,000 'under the ditch'.

In British Columbia, in addition to several small projects built prior to 1935, some 3,900 acres have been brought under irrigation by P.F.R.A., with further projects now under study to serve some 48,000 acres. The recently completed Lilloet project has resulted in protection of land under cultivation and in the reclamation of an additional 14,000 acres. In all, some 30,000 acres of high class land were salvaged. Several major large irrigation projects are built and under operation in Alberta and Saskatchewan. These are in addition to the larger projects built prior to 1935 and operated as Districts by the water users, such as the two projects drawing water for 250,000 acres from the Bow River at Calgary and at Bassano (originally built by Canadian Pacific Railway), and the Lethbridge Northern Irrigation District of 75,000 acres.

Among the P.F.R.A. projects is the St. Mary project for watering 510,000 acres in the Lethbridge Medicine Hat areas, now partly completed jointly with the Alberta government. A second is the Bow River Project taken over by P.F.R.A. from a private company in 1951, which now waters some 60,000 acres out of a potential total of 240,000. In Saskatchewan there are some ten P.F.R.A. projects in operation now serving 142,000 acres with water, whose ultimate irrigable potention is some 530,000 acres. Besides these, the huge south Saskatchewan project, which may be undertaken in 1958, would bring water to another 470,000 acres.

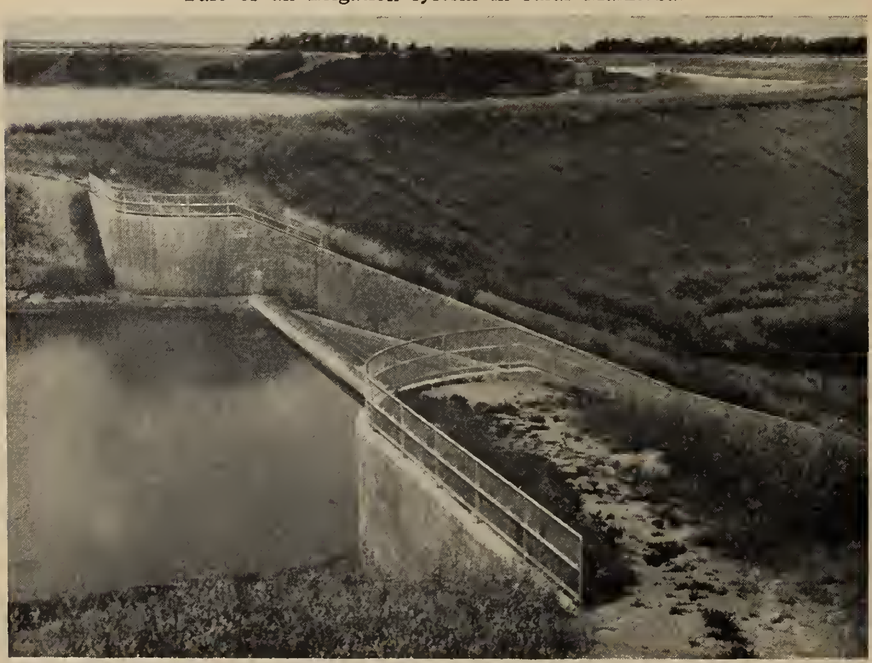
Though no large irrigation projects are built or proposed for Manitoba, at the Pas (northern Manitoba) the Saskatchewan River Reclamation project is under way for reclaiming a million acres from annual flooding in the delta of the river. Canada's share of 35,000 acres in Manitoba is now completed.

Land Utilization

Expenditure to the same date on the Land Utilization Program, which involves 61 separate "community pastures", has totalled $13.5 million. On cultural work and on soil drifting control, expenditures were $4.97 million including administration and equipment at $1.64 million and $4.07 million, respectively.

The land utilization policy is based on a complete soil survey of the prairie provinces covering an area of 50 million acres. It provides a means of taking sub-marginal land out of cultivation and regrassing these areas for grazing purposes as 'community pastures'. Some 1,750,000 acres so far have been taken out of cultivation, and 200,000 acres have been regrassed. Sixty-one operating units at present graze 110,000 cattle yearly. Measures are also provided for control and prevention of soil drifting and erosion, for encouraging improved tillage and cropping practices, and for tree-planting.

Part of an irrigation system in rural Manitoba.



The Department of Trade and Commerce 'Survey of Capital Investment Intentions' for 1957 disclosed proposed expenditures by the Federal government for dams, reservoirs, and irrigation and reclamation projects during 1957 at some $10.3 million, while total proposals in these categories by Federal and Provincial governments added up to some $42 million in the four western provinces. These expenditures may be equalled or exceeded during 1958.

MARITIME MARSHLANDS REHABILITATION

Under the Maritime Marshlands Rehabilitation Act of 1948, Canada participates with the provinces of Nova Scotia, New Brunswick and Prince Edward Island in construction and reconstruction of protective works to prevent tidal flooding. The provinces negotiate agreements with groups of marshland owners, build and maintain fresh water drainage ditches and promote effective land-use programs. Headquarters of the Administration was established at Amherst, N.S., and the Director is responsible to the Federal Department of Agriculture.

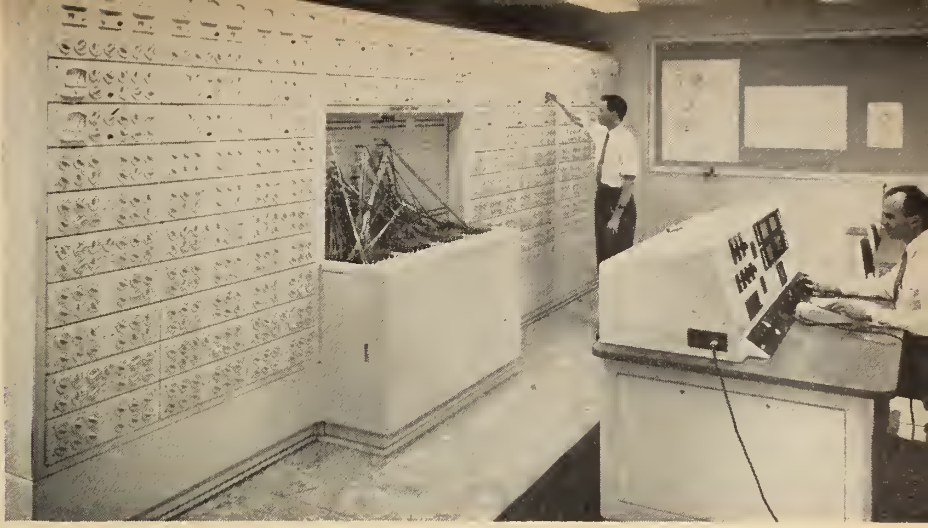
The Marshland areas are mainly adjacent to rivers flowing down into the Bay of Fundy, comprising some 100,000 acres. Up to the end of fiscal year 1956/57 active and non-active projects approved or being considered for active projects included 73,388 protected acres and 13,502 unprotected (salt marsh) acres. Total acreages in projects, by provinces, were, Nova Scotia 44,471; New Brunswick, 39,174; and P.E.I., 275. Non-active projects included 2,217 acres in Nova Scotia and 1,887 acres in New Brunswick.

Federal expenditure to end of fiscal year 1956/57 totalled $11.93 million, of which $4.28 million was spent in Nova Scotia; $3.72 in New Brunswick; and some $20,000 in Prince Edward Island. Federal administration, engineering, workshops, and supervision totalled $3.36 million.

Special Projects

Studies have been made as to the feasibility of building a dam across the Annapolis River. Such a structure, with adequate fresh water discharge facilities would protect some 4,300 acres of marshland. A similar project has been studied for a dam across the Tantramar River to protect 18,000 acres of marshland. It is expected these two projects will be undertaken at an early date.

An electric network analyzer, right, recently installed in the University of Alberta, for which $100,000 was provided by Calgary Power Limited — an example of collaboration between university and industry. Below is a Miller high-speed photographic recorder, the first of its kind in Canada, used by Orenda Engines Limited in conjunction with their aero-engine test cells. Sixteen different recordings can be made simultaneously.



RESEARCH AND DEVELOPMENT

PURE AND APPLIED research programs are under way in many centres in Canada, and it is not possible, here, to deal with the many phases of work in detail.

In general, research and development programs are carried out by government, universities, independent research organizations, and industry. The National Research Council, established in 1916 by the Government of Canada under its full title of the Honorary Advisory Council for Scientific and Industrial Research, is the largest centre for research in the country. The Ontario Research Foundation serves many industrial fields, and the Pulp and Paper Research Institute serves the pulp and paper industry.

Research in engineering subjects at Canadian universities is now developing more rapidly than hitherto, and it is hoped to give some further details of this work in a later issue of *The Engineering Journal.*

Apart from the resource industries of Canada, such as agriculture, mining, and pulp and paper, indigenous industrial research has been rather limited in comparison with the United Kingdom, the United States, and the U.S.S.R. This has partly been due to the existence of many large industrial organizations which rely on parent companies in other countries, notably in Britain and the U.S.A., for their basic research and development work. It is not possible to compile accurate figures for research expenditures by Canadian industry.

Figures for government expenditure in 1957 on research in Canada are not yet available, but in the fiscal year 1956/57 this amounted to some $105 million plus about $30 million on defence development contracts.

National Research Council

The National Research Council (N.R.C.) in 1956/57 had an operating budget of about $20 million, of which $3.5 million was devoted to scholarships and assisted research grants to universities, and so on. Of some 540 research scientists, about 170 were engineers.

The N.R.C. has five laboratory divisions, three engineering divisions (Building Research, Mechanical Engineering, and Radio and Electrical Engineering), two regional laboratories (Halifax and Saskatoon), and a Division of Medical Research.

In 1957 a separate Northern Section was formed to continue northern research work, and the station at Norman Wells, N.W.T., which has a completely-equipped soil mechanics laboratory, is the base for permafrost studies and work on northern building problems. Another important new development which neared completion

Above: new metallurgical and chemical laboratories of the Steel Company of Canada. Centre: library of the Division of Building Research, N.R.C. Bottom: a sub-critical nuclear reactor being checked before delivery to the University of Toronto. Research in atomic energy is developing rapidly in Canada.

during 1957 is the Fire Laboratory, being built near the Building Research Centre, in Ottawa. (In 1955 a total of 76,000 fires in Canada resulted in a property loss of $103 million and the far more serious loss of 569 lives.)

Aeronautical Engineering

Research and development in aeronautical engineering is carried out by the major aircraft and other industries, and at N.R.C.

Civil Engineering

The Division of Building Research, N.R.C., is very active in work on construction problems. Among the university programs is work being done on the plastic theory of structural design.

Chemical Engineering

Research in pure and applied chemistry and in chemical engineering is fairly active in Canada. During 1957 several industrial laboratories were completed or under construction to serve such fields as plastics, coated fabrics, and explosives.

Electrical Engineering

In addition to the work of the Radio and Electrical Engineering Division, N.R.C., several industrial research laboratories were active in 1957. Development work has resulted in new scatter communication equipment for extended telephone and television circuits. The new Fetherstonhaugh high voltage laboratory at the University of Manitoba will ultimately provide complete high-voltage testing facilities.

Mechanical Engineering

Work on many aspects of mechanical engineering and metallurgy continued in 1957, notably at N.R.C. Research on metal cutting was pursued at the university level for eventual industrial application.

Mining Engineering

Towards the development of Canada's mineral resources, the Government authorized, in 1957, the expenditure of over $6 million to map about 500,000 square miles of Arctic Canada. Many other development programs were under way, and some are mentioned in this issue under Mineral Resources. The Consolidated Mining and Smelting Company opened a new $250,000 research wing during the year at its centre at Trail, British Columbia.

40 YEARS OF PUBLICATION

THIS ISSUE completes forty years of uninterrupted publication of *The Engineering Journal*, which was started during the first World War and survived the depression years of the 'thirties and a second World War.

During these forty years, "the *Journal*," as it has familiarly become known to its readers, has maintained a consistently high editorial standard and has provided a unique record of the impressive development of Canada through the great engineering and other works that have helped to make the country what it is today.

The First Issue

The aims of the *Journal* were well expressed in the May 1918 issue by the words of Fraser S. Keith, then secretary and first editor and manager of the new publication for which he was largely responsible.

> Your faith that some day an intercommunicating medium would be provided, devoted to the welfare of the Institute and its members, assumes realization in the appearance of this, the first issue of the Journal of the Engineering Institute of Canada.
>
> It is yours.
>
> With you rests the decision as to its future . . .
>
> Just how human it may become will be determined by the amount of active co-operative interest you take in it. Here, all that pertains to the doings of the Institute, will receive full and free discussion. In it, our activities and our expectations may find expression.

The timing of the first issue was particularly appropriate. In April 1918 the Bill to secure adoption of the name The Engineering Institute of Canada was passed by the Senate and received the approval of the Governor General in Council. From its founding in 1887, what now became the Institute had been known as the Canadian Society of Civil Engineers (in distinction to the military engineering field). Furthermore, the *Journal* was able to record the first general professional meeting, held in March 1918, in Toronto.

Following a foreword by H. H. Vaughan, the first president of the Institute under its new title, the *Journal* records the discussion at the meeting of the existing fuel and power situation in Canada, which 'marked a new era in the affairs of the Engineers in Canada, by meeting to discuss a question of general public interest'.

Since that time the 'Engineers in Canada' have contributed greatly to many questions of public interest, and the *Journal* has faithfully recorded their work.

Function of the Journal

Among the features to be published in each issue of the *Journal* were: minutes of Council meetings; reports from branches; applications for admission and transfer; papers to be published in *Transactions* and to be presented at general professional meetings; branch papers of merit; discussion of papers; correspondence; letters from members serving in the armed forces; 'personals'; an engineering index or review of current engineering literature; and an employment bureau. Many of these sections are familiar today.

Physical Growth

The editorial content of the first issues of the *Journal* was not small by existing standards, averaging over 50 pages per issue in 1918, including the Engineering Index. However, the membership in that year was just over 3,200.

In recent years the *Journal* has contained over 100 pages of editorial material per issue, and nearly 20,000 copies of the publication for April 1958 will be printed.

Major Features

Throughout its history the *Journal* has presented information of interest and assistance to the members of the engineering profession and has followed the progress of industry and other developments in Canada.

Some of the major fields dealt with are: the development of aviation in Canada, mentioned as early as 1919; the development of the St. Lawrence as a traffic route, including the Welland Canal works; the progress of power; the construction of large bridges, buildings, transport and communication facilities of vital interest to the nation's growth; the development of the country's natural resources; and, not least, the development of the profession through engineering education.

Notable Issues

Some notable issues of the *Journal* have been devoted to subjects of particular importance, and a few are mentioned here.

In 1924 the first World Power Conference was held in London, England, and the July issue contained 228 pages of editorial material, mostly devoted to the Canadian contribution to the Conference. The authors of papers included such well-known names as J. B. Challies, B. P. Haanel, H. G. Acres, Julian C. Smith, F. A. Gaby, L. E. Westman, and Lawrence J. Burpee.

In 1925 Fraser S. Keith retired as secretary and editor, and was succeeded by R. J. Durley. An important symposium on engineering education was recorded this year.

A prominent paper published in April 1929 was 'The St. Lawrence Problem', by Lesslie R. Thomson. This is still a masterly review of transport, power, and economics of the waterway; it occupies 116 pages of the issue.

The Canadian contribution to the second World Power Conference, held in Berlin, is recorded in the *Journal* for July 1930.

The following year, an interesting editorial comment on a review made by United States engineering societies on the conditions of employment of professional and technical men in Russia, noting that 'it has been found necessary to enlist the aid of a large number of technically trained men from capitalist countries to plan and operate projects in the U.S.S.R.' At that time the Russians were implementing great plans for the country's industrial development.

During the depression years of the 'thirties, there are many mentions of the work of the Institute in promoting relief measures, such as the National Committee on Construction Recovery, on which several members served.

In 1935 and 1936 major subjects discussed included water resources and soil conservation in the prairie provinces; and the development of civil aviation, stressing the future importance of Canada as a link in the world's airways.

Semi-Centennial of the Institute

The Coronation of King George VI was marked in 1937, which was also the semi-centennial year of the Institute. The special June issue of the *Journal*, in 230 editorial pages, recorded fifty years of Canadian achievement in engineering and industry. The following month over 80 pages of papers dealt with Canadian coals, and a later issue noted the new North Atlantic air service between London and Montreal.

In 1938 R. J. Durley retired as general secretary and editor, and was succeeded by L. Austin Wright. Already this year, the world situation was reflected in an editorial 'War and the Engineer'.

War and Post-War Years

During the war years the *Journal* continued its service and helped in the contribution made by Canadian engineers to the war effort. The wartime paper shortage affected the *Journal*, which had adopted an improved style and introduced wider coverage of subjects, and several economies were introduced, including dropping certain departments.

After the war, the emphasis was on rehabilitation and post-war recovery, and hitherto restricted subjects such as radar and atomic energy were discussed.

In the last ten years, the development of Canada has been at a greatly accelerated rate. The same rapid development can also be seen in the *Journal*.

The amount of editorial material, the fields covered, and the circulation have all increased, and the style of the presentation has been improved to make reading easier for the busy engineer.

The *Journal* has not stood still during its forty years of life, and its aim is always to serve the engineering profession in Canada by the best possible means.

THE ADVERTISERS

Many engineering and industrial organizations have made their contributions to the pages of *The Engineering Journal* during the past forty years. These contributions have been factual and informative, and their 'editorial' value to the reader must not be overlooked. A review of the part played by these organizations since 1918 appears on page 232.

CONTRIBUTORS TO THIS ISSUE

This review of engineering and industrial progress in Canada during 1957 has been made possible by the co-operation of many government departments, industrial organizations, and individual contributors. Though they cannot all be named here, **The Engineering Journal** wishes to express sincere appreciation for their assistance.

Particular thanks are due to Mr. H. G. Cochrane (Life Member, E.I.C.) who undertook extensive statistical research and prepared most of the reviews published here.

The assistance of those who supplied illustrations of many recent developments in Canada is also appreciated, and the names of these contributors to the various sections of the review are listed below.

Mineral Resources
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Calgary Power Limited; Orenda Engines Limited; The Steel Company of Canada Limited; National Film Board; Canadair Limited.

SEVENTY SECOND

ANNUAL GENERAL AND PROFESSIONAL MEETING

OF

THE ENGINEERING INSTITUTE OF CANADA

MAY 21, 22, 23, 1958

CHATEAU FRONTENAC, QUEBEC, QUE.

ANNUAL MEETING NOTES

REGISTRATION

Members of the Institute have received in the mail the Preliminary Program giving detailed and complete information about the annual meeting. The program of this meeting will be centred in and around the Chateau Frontenac.

It is a distinct advantage to members and to the Headquarters staff, if members register in advance. The Preliminary Program contains information about the procedure of advance registration through Headquarters. This arrangement will be in effect until Saturday, May 3; thereafter reservations must be made by direct communication with the Quebec hotels. Registration at Quebec opens on Tuesday, May 20 at 3.00 p.m., and continues each morning at 9.00 a.m.

ACCOMMODATION

The Chateau Frontenac has reserved accommodations for 700 people. Accommodations will also be available at alternate hotels and motels in the Quebec area.

CONFERENCES

Three conferences will start on Tuesday, May 20 — the Students' Conference, at 9.00 a.m., and the Branch Officers' Conference and the Engineering Deans' Conference at 9.30 a.m. Delegates to these conferences will attend a joint luncheon on May 20.

ANNUAL MEETINGS

The Annual Meeting of Council is scheduled for 10.00 a.m. on May 20, and the Annual General Meeting of the Institute at 10.00 a.m. on May 21.

TECHNICAL PROGRAM

The technical program is listed on the next two pages. Thirty-two papers are to be presented, which can be classified under the fields of civil engineering, mechanical and thermal power, electrical, chemical, metallurgical, aeronautical, and mining engineering, and general, including science and physics. The subjects represent many of the important concerns of engineers—from highway design to aircraft systems, electronic computing, power plants, and the International Geophysical Year. There will be two speakers from England.

The technical program will start on Wednesday, May 21, at 2.00 p.m., and will be concluded late on Friday afternoon.

For more information, please read the following three pages.

TECHNICAL PROGRAM

Subject to change

WEDNESDAY, MAY 21

2:00 p.m.

Economic Study of Pump Storage Application

Dr. Charles Jaeger, Consulting Engineer to English Electric Co., England.

The Deas Island Tunnel

Per Hall, M.E.I.C., Executive Vice-President, Foundation of Canada Engineering Corp. Ltd., Montreal.

Partial and Complete Sewage Treatment

Jacques Benoit, M.E.I.C., Consulting Engineer, Montreal.

Non-Destructive Testing of Materials and Parts

W. E. Havercroft, Radiographer, Physical Metallurgy Division, Dept. of Mines and Technical Surveys, Ottawa.

3:00 p.m.

Variable Pitch Mixed Flow Propeller Pump Turbines

J. G. Warnock, Head, Hydraulic Department, English Electric Company Limited, Toronto, Ont.

The Deas Island Tunnel (Continued)

E.I.C. ANNUAL MEETING, 1958

Quebec-Labrador Tropospheric Scatter Radio System

D. J. McDonald, Area Radio Engineer, The Bell Telephone Company of Canada, Montreal; and C. E. Frost, M.E.I.C., Construction Contract Engineer, Bell Telephone Company of Canada, Montreal.

Correction of Non Linearities Using Varistors

Lieut.-Col. G. W. Holbrook, M.E.I.C., Head, Department of Electrical Engineering; Royal Military College, Kingston, Ont.

4:00 p.m.

Combatting Ice and Snow Conditions

J. E. Cousineau, M.E.I.C., Surveys Engineer, Power Development Division, Hydro-Quebec, Montreal.

Quebec-Labrador Tropospheric Scatter Radio System (Continued)

New Concept of Engineering in Semiconductor Device Development

J. A. Watters, M.E.I.C., Superintendent of Engineering Methods, Northern Electric Company Limited, Montreal.

THURSDAY, MAY 22nd

9:00 a.m.

Baie Comeau Plant, Canadian British Aluminium Co. Ltd.

V. M. Wallingford, M.E.I.C., Resident Engineer, Canadian British Aluminium Co. Ltd., Baie Comeau, Quebec.

Cavitation Damage of Metals

W. C. Leith, M.E.I.C., Mechanical Research Engineer, Dominion Engineering Works Limited, Montreal.

Electronic Computing in Engineering

B. J. Kaganov, Assistant Chief Engineer for Research and Development, Canadair Limited, Montreal.

10:00 a.m.

Baie Comeau Plant, Canadian British Aluminium Co. Ltd. (Continued)

Thermal Power Generation

Basil Wood, Head of Research & Development Department, Merz and McLellan, Consulting Engineers, London, England.

Civil and Structural Engineering Aspects of Electronic Computer Applications

A. M. Lount, M.E.I.C., A. M. Lount and Associates, Consulting Engineers, Toronto.

11:00 a.m.

Baie Comeau Plant, Canadian British Aluminium Co. Ltd. (Continued)

The Georgia Generating Station, Vancouver Island

J. P. Sinclair, Project Engineer, British Columbia Power Commission, Victoria, B.C.

TECHNICAL PROGRAM

Subject to change

Photogrammetry and Its Application to Engineering

T. J. Blachut, National Research Council, Ottawa, Ont.

FRIDAY, MAY 23rd

9:00 a.m.

The International Geophysical Year

Dr. D. C. Rose, M.E.I.C., Principal Research Officer, National Research Council, Ottawa. Chairman of the Canadian National Committee, for the International Geophysical Year.

Engineering Features of the Beechwood Development

J. A. Thomas, M.E.I.C., Chief Engineer, Civil Division, Shawinigan Engineering Co. Ltd., Montreal; R. E. Grout, M.E.I.C., Chief Engineer, Elect. Division, Shawinigan Engineering Co. Ltd., Montreal.

Aluminum in Railway Rolling Stock

R. A. Campbell, Manager, Development Division, Railway-Marine, Aluminum Company of Canada, Montreal.

The Preparation of Ilmenite Ore for Smelting

George E. Wagner, Operations Superintendent, Quebec Iron & Titanium Corporation, Sorel, Quebec.

10:00 a.m.

The C.A.R.D.E. IGY Upper Air Research Program

R. F. Chinnick, Superintendent, Electronics Wing, C.A.R.D.E., Quebec.

Design Features of the Beechwood Kaplan Turbines

L. M. Boyd, M.E.I.C., Chief Engineer, Hydraulic Division, Dominion Engineering Works, Limited, Montreal; W. S. McIlquham, M.E.I.C., Hydraulic Engineer, Hydraulic Division, Dominion Engineering Works, Limited, Montreal.

Design and Development of Control System CF-105 Aircraft.

Colin Marshall, Chief of Systems Engineering, Avro Aircraft Limited, Toronto.

Varennes Operation, English Reduction Company

R. M. O. Maunsell, Vice-President, Research & Development, Electric Reduction Company of Canada, Ltd., Toronto.

11:00 a.m.

Modification of the Jacques Cartier Bridge

Ross Chamberlain, M.E.I.C, Engineer, Structural Design Department, Dominion Bridge Co. Ltd., Montreal.

Vertical Take-Off Aircraft and Their Power Plants

P. J. Pocock, Low Speed Aerodynamics Laboratory, National Research Council, Ottawa; and Dr. E. P. Cockshutt, Engine Laboratory, National Research Council, Ottawa.

2:30 p.m.

Underground Hydro-Electric Power Stations

F. L. Lawton, M.E.I.C., Chief Engineer, Power Department, Aluminum Company of Canada, Ltd., Montreal.

Highway Research Activities in Canada

Dr. Gordon Campbell, JR.E.I.C., Director of Technical Services, Canadian Good Roads Association, Ottawa.

3:30 p.m.

Management Panel

Particulars to be announced.

Design of a Functional Structure In or On Rock

A. V. Corlett, M.E.I.C., Head, Dept. of Mining Engineering, Queen's University, Kingston, Ont.; and C. L. Emery, M.E.I.C., Professor, Engineering Department, Waterloo College, Waterloo, Ont.

QUEBEC CITY, MAY 21, 22, 23.

Lower St. Lawrence North Shore Highway Development

Arthur Branchaud, Assistant Chief Engineer, Department of Roads, Quebec.

4:30 p.m.

Management Panel (Continued)

Nelson River Bridge at the Kelsey Generating Station

J. R. Rettie, M.E.I.C., Manager, Surveys and Construction Division, The Manitoba Hydro-Electric Board, Winnipeg, Man.; and P. A. Benn, M.E.I.C., Executive Vice-President, Pre-Compressed Concrete Engineering Co. Ltd., Montreal.

Fundamentals of Transportation Engineering

S. M. Breuning, M.E.I.C., Assistant Professor of Civil Engineering, University of Alberta, Edmonton, Alta.

E.I.C. ANNUAL MEETING

MEETING NOTES (continued)

SOCIAL EVENTS

The President's Dinner for past and present Institute officers and special guests will be at 7.00 on Tuesday evening, May 20.

The Wednesday Dinner, 7.00 p.m., will be presided over by Roger Desjardins, Quebec Branch chairman, with C. M. Anson, retiring president of the Institute, addressing the assembly. There will be dancing from 10.00 p.m.

Thursday's program includes, at 7.30 p.m., the annual dinner of the Association of Consulting Engineers of Canada. There is a tentative arrangement for a buffet supper for E.I.C. members at the same time Thursday evening. The decision about this depends on the response indicated in advance registration. There will be dancing again on Thursday evening.

ANNUAL BANQUET AND DANCE

The annual banquet and dance will be on Friday, May 23. C. M. Anson, retiring president will preside. During dinner he will introduce the new president, K. F. Tupper, and the new members of Council. The speaker will be R. G. Gustavson, president and executive director of Resources for the Future Inc., Washington, D.C.

All places for the annual banquet will be reserved. Members who wish to be seated with friends or in special parties must provide this information with advance registration. Places will be allocated in the order in which they are received.

LUNCHEONS

Luncheons on Wednesday and Thursday are informal with members making arrangements independently. Friday's luncheon, at 12.30, will be the occasion of the presentation of the Institute honours and awards. Chairman will be Vice-President Albert Deschamps.

BOAT TRIP AND FIELD TRIPS

On Thursday at 2.00 p.m. there will be a scenic boat trip on the St. Lawrence River, with music and refreshments by courtesy of the Quebec Branch. Special field trips may be organized for Saturday, the 24th. The committee will arrange them as required.

PHOTOGRAPHIC EXHIBITION

The Photographic Exhibition will again be a feature. Canadian firms and individual members will be exhibiting photographs of Canadian engineering achievements of 1957. Please see page 254 for details.

ANNIVERSARY OF QUEBEC

Many historic and entertaining attractions are to be found in Quebec. This year, Quebec will celebrate its 350th anniversary, and honour is being paid to the great Samuel de Champlain, who erected the first settlement in 1608.

LADIES' PROGRAM

The ladies can be assured of a gracious welcome. There will be a Ladies' Program prepared by the ladies' committee, headed by Madame Roger Desjardins and Mrs. Ben O. Baker.

TRANSPORTATION

The Preliminary Program contains information about railway, air, and road travel. The usual reduced convention train fares will be available under the conditions listed there. Air lines normally grant reduced fares to parties of ten persons or more.

QUEBEC COMMITTEE

Chairman: Ben O. Baker

Treasurer, Pierre Duchastel

Publicity, Louis Joncas, Jacques Roy

Reception and Transportation, Jean B. Delage

Vice-Chairman, Roger Desjardins

Meeting arrangements, L. P. Bonneau

Entertainment, Paul Begin

Secretary, Marc Bergeron

Ladies' Committee, Mme Roger Desjardins, Mrs. Ben O. Baker

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

E.I.C. and Saskatchewan Association

The first of all the associations to sign the co-operative agreement with The Engineering Institute of Canada was Saskatchewan. This was done in 1938.

Conditions have changed materially in Saskatchewan as they have in other provinces and today there are many people practising there under the Professional Engineer's Act who are not, strictly speaking, engineers. This refers to such persons as geologists, geophysicists, etc.

One of the features of the Saskatchewan agreement is that a member joining the Association automatically becomes a member of the Institute. With the new types of professional workers coming into the province, it was only natural that some of them would prefer to belong to a specialized society catering particularly to their specialty rather than to The Engineering Institute. They have suggested to the Association that the agreement be altered, so that membership in the Institute would be optional.

The matter was discussed very widely at the annual meeting of the Association and the outcome was that it was agreed that a referendum be circulated in which the whole matter would be gone into in considerable detail. The referendum proposed these alternatives:

1) That the agreement be left as it is.
2) That E.I.C. membership be made optional.
3) That the agreement be cancelled.
4) If the ballot showed a majority in favour of cancelling the agreement, would the members (a) retain their E.I.C. membership (b) drop their E.I.C. memship in favour of some other organization.

At the recent annual meeting of the Association, the results of the referendum were reported. The ballot is quite clear and gives encouraging support to the maintenance of the present relationships between the Association and the Institute. Here are the results:

Question 1 would suggest that the agreement be left as it is. 76.4 per cent voted in favour of this. That membership in the E.I.C. be made optional was supported by 23 per cent, whereas the inquiry as to cancelling the agreement entirely was supported by only .6 per cent.

In answer to what action would be taken by the members if the agreement were cancelled, the replies were far from complete. 31.4 per cent of the persons voting recorded no opinion on this question, which seemed to suggest they were not interested in it and therefore were not keen on dropping out of the Institute. Only 13.1 per cent suggested that they would drop their membership if it were made optional.

Although there was no question to cover it, it was interesting to note that three members said that if the agreement were cancelled, they would retain their E.I.C. membership but would drop their Association membership.

All in all, these results are very comforting to the people who are responsible for the operation of both these organizations. It indicates that the oldest agreement of all, has in a general way, met the needs and the wishes of the membership.

"The Fathers of Confederation", taken at the meeting of the two committees at Toronto, January 18, 1958. Left to right: H. T. Libby, Vancouver, T. Foulkes, Ottawa, I. R. Tait, chairman, E.I.C. committee, Montreal, L. J. Hammerschmid, secretary, E.I.C. committee, Montreal, John Fox, chairman, Canadian Council committee, Toronto, W. S. Wilson, Toronto, J. G. Dale, Edmonton, Henri Gaudefroy, Montreal, James McMillan, Calgary, J. H. Smith, Toronto, G. Piette, Quebec, W. O. Richmond, Vancouver, D. O. Turnbull, Saint John, H. W. L. Doane, Halifax.

In Honour of a Great Engineer

C. M. Anson, left, with Mrs. C. S. McGaffin, daughter of the late Henry J. Cambie, Dr. L. Austin Wright, of the E.I.C., Harry B. Cambie, son of the famous engineer being honoured on this occasion, and Mrs. N. F. Townsend, another daughter.

The Institute's memorial tablet to H. J. Cambie, M.E.I.C., was unveiled by the president of the Institute, C. M. Anson, on Monday February 10th, in the Canadian Pacific Railway station at Vancouver, B.C.

This tablet was first put on view at the annual meeting of the Institute in Banff in June, 1957. Since then it has gone to Vancouver and has been placed in its permanent position on the wall of the Vancouver depot. It seems appropriate that that should be the site of the memorial in view of the fact that it was Mr. Cambie himself who was responsible for Vancouver being selected as the terminal for the great Canadian Pacific Railway system.

The audience attending the ceremony was made up of about 200 Vancouver citizens and included a great many people in engineering and other circles who had known Mr. Cambie and his family.

The three most important members of the audience were Mr. Cambie's own children. His two daughters Mrs. N. F. Townsend, Mrs. C. S. McGaffin and his son Harry B. Cambie. All three of them are shown in the accompanying photograph.

The president sketched out for the audience some of the many and important accomplishments of Mr. Cambie's career. He made reference also to the fact that Mr. Cambie had achieved a great place for himself in other circles as well as engineering. The president's address follows this short item.

Others who participated in the service were T. E. Price, M.E.I.C., who spoke on behalf of the family. Mr. Price knew Mr. Cambie and his family intimately and throughout their joint services to the C.P.R. they had many things in common.

Accepting the tablet on behalf of the Canadian Pacific Railway Company was J. N. Fraine who also had been a close associate of Mr. Cambie. The memorial itself consists of a large shield made of stainless steel. Probably this is the first time that stainless steel has been used for this purpose and the results have been very gratifying.

In one corner is the crest of The Engineering Institute of Canada and in the other an excellent etching of Mr. Cambie. The inscription reads thus:

"In recognition of the outstanding engineering achievements of Henry John Cambie, M.E.I.C., 1836-1928, whose surveys and explorations determined the location of the Canadian Pacific Railway through British Columbia and who supervised its construction through the Fraser River Canyons, 1880-1884. Erected and dedicated by The Engineering Institute of Canada, June 1957."

This concludes another event in the Institute's program of commemorating

This large group attended the ceremony in Vancouver honouring the achievements of the late Henry J. Cambie, C.P.R. engineer.

the memory of the early and great Canadian engineers. First there was the fountain erected in Ottawa in memory of Colonel By; then the book "Daylight through the Mountain" in honour of the Shanly Brothers; and now this latest tribute to the distinguished gentleman who did so much to solve the almost impossible problems of the railroads in British Columbia. The Institute has other projects in mind to honour other worthy engineers, details of which will be made available later.

Dedication by C. M. Anson

We are gathered together this afternoon to honour a great Canadian engineer, one of the stalwart men who laid the foundations, and laid them well, upon which Canada has grown to nationhood. Henry John Cambie, member of The Engineering Institute of Canada, was one of that elite coterie of men who in the early stages of our country's development had the courage and vision to do things which even today with our modern facilities are looked upon as almost impossible tasks.

In recent years we have seen and have regarded with wonder, such projects as Shipshaw in Quebec, the St. Lawrence Seaway, the wonders of Alberta oil, and the Kitimat project, but with our modern means of transportation, our tools which make work easy, such projects pale almost to insignificance beside the project of nearly one hundred years ago of building a railway from Winnipeg through to the foothills of Alberta and thence over what to most people must have seemed an insurmountable barrier, the Rockies, and into Vancouver. Thank God for such men as Henry John Cambie.

Born in Ireland, at 16 he came to Canada with his parents and shortly thereafter embarked on his life's work, entering the employ of the Toronto and Guelph Railway. Later he worked for engineering contractors building the Grand Trunk Railway. In 1861 he qualified as a land surveyor and in that profession conducted surveys and explorations for several of the early railway systems in Maritime and Central Canada.

Eighty-seven years ago British Columbia entered Confederation and one of the stipulations of that agreement was that a transcontinental railway would be built. Some years of the usual procrastination attendant on such matters followed. Many personalities entered the picture, played their part and faded away. Finally Henry Cambie was placed in charge of surveys and explorations in British Columbia. From 1876 to 1878 the different passes over the Cascade Mountains were surveyed and the route from Burrard Inlet via the Fraser and Thompson Rivers was selected by Cambie as the most favourable. While his recommendation was not accepted immediately and indeed was the subject of violent opposition for some considerable time, the thoroughness with which his surveys had been carried out and the logical conclusions which Cambie had reached, finally prevailed. The route through the Fraser River Canyons was adopted.

Henry Cambie's work was just starting. He was engineer in charge of construction for that part of the work running from Emory's Bar to Boston Bar territory which included the most difficult 29 miles through the canyons. This work was completed in 1884 and Cambie who up to that time had been in the employ of the Federal Government, joined the staff of the Canadian Pacific Railway as engineer in charge of construction from Savond eastward to Shuswap Lake. In 1885 he had the supreme satisfaction of seeing the railway that he had envisaged, over a route which he had selected, finally completed by the symbolic driving of the last spike. He was present at that ceremony as representative of the railway engineers. For 35 years after that memorable date Henry Cambie continued in full active service. Upon his retirement in 1920 the C.P.R. still retained him as consultant.

Many of you here today must also recall Cambie's activity in community, church and professional affairs. His signature appears among those who applied for the charter of the City of Vancouver. Christ Church acknowledges his worth as a Christian by a memorial window. Vancouver has perpetuated his memory by naming a street after him, and the C.P.R. has a station called Cambie.

The members of his profession, the engineers of Canada through their national body, The Engineering Institute of Canada, an Institute of which he was proud to be a member and to which he rendered active service as member of Council, also desire to give tribute. To that end and so that future generations of Canadians shall not forget or overlook the magnificient contributions made by those whose vision and courage made our Canada possible, I have the honour and privilege of unveiling this plaque.

The Engineering Institute of Canada, on behalf of the engineers of Canada, present this plaque to the Canadian Pacific Railway and to the people of Canada to honour Henry John Cambie and to recognize his outstanding engineering achievements from 1836 to 1928. On behalf of the Institute I hereby dedicate this plaque to the memory of a great engineer, an outstanding Canadian.

May his works be an inspiration to the engineers of future generations. May his courage and vision be with us always.

"S.E.I.C."

A study of the membership figures of the Institute indicates that there has been a substantial increase in the number of students joining the organization. Although the enrolment is not yet complete for the college year the figures for new applications from September to March are in excess of 1,500.

This increase, added to the numbers within the Institute previously, now brings the total to over 4,000 S.E.I.C's.

While it is possible to be pleased with these figures it must be admitted there is still room for improvement. It is hoped that the acceleration which is now under way will continue throughout the years so that eventually the numbers will be even more impressive. The significant thing is that these figures are the highest ever achieved by the Institute.

This increase in applications follows several developments, not least of which is the Student Conference held every year at the time of the annual meeting. The creation of faculty advisors last year also has been helpful, and acknowledgement must be made of the wonderful support given at most universities by one or more members of the faculty who have passed on to the students some of their enthusiasm for the Institute.

Did You Know That...

The Engineering Institute holds a Student Conference every year as a feature of the annual meeting. The E.I.C. Education Conference also forms part of the annual meeting, when Council directs.

Toronto and Points West in the President's Tour

Saskatoon—the Branch dinner dance. Left to right: L. Austin Wright, Mrs. I. M. Fraser, President C. M. Anson, Mrs. W. G. McKay, H. McI. Weir, Mrs. Anson, Dean I. M. Fraser, Mrs. Weir. and W. G. McKay.

Mr. Anson presented student prize to Robert G. McIntosh, at the University of Saskatchewan.

Chairman of the Toronto Branch E. R. Davis (standing), introduced the president.

Edmonton. The executive met with the president. Left to right: H. Hole, H. L. Roblin, R. H. Nicolson, J. Langworth, S. J. Hampton, S. R. Sinclair, T. H. Newton, R. N. McManus, R. Hardy, R. H. Gardener, G. Hodge, A. Peterson. C. M. Anson is in the foreground.

Regina. Left to right: E. J. Durnin, J. C. Traynor, C. M. Anson.

In Toronto, Mr. Anson was interviewed by Percy Saltzman on the Tabloid T.V. program.

Fetherstonhaugh High Voltage Laboratory

The *Journal* Reports Growth in Engineering Faculties in Canada

Fourth article of a series

The University of Manitoba

Degree courses offered at the University of Manitoba are those of civil, electrical, mechanical and geological engineering, and engineering physics. The fiftieth anniversary of formal engineering instruction at this university was celebrated in March 1957.

A. E. Macdonald, M.E.I.C., dean of engineering and architecture, has advised that the undergraduate curriculum is in a quite stable form, with no extensive changes at present contemplated. Curricula are under constant review however, and subjects are revised, added, or dropped, as found to be advisable or feasible.

There is a slight trend, Dean Macdonald reports, toward an increase in fundamental mathematics and science subjects at the expense of the "practical" subjects. There already is a core of humanistic-social subjects.

The university has observed a mounting demand for graduate courses and expects to satisfy this demand as it increases further by means of additional courses.

Physical expansion in the engineering faculties has been accomplished by the addition of the Fetherstonhaugh high voltage laboratory, formally opened on March 22, 1957, and will be further affected by new extensions to existing mechanical, civil and electrical laboratories.

High Voltage Laboratory

The Fetherstonhaugh high voltage testing laboratory has a frontage of approximately 60 feet and a depth of approximately 64 feet. It provides a high voltage testing area as well as accommodation for a sub-laboratory for the Canadian Standards Association. The former occupies a clear open space some 37 feet by 60 feet by 38 feet high, with a large roll-up entrance door providing an opening some 22 feet high by 16 feet wide for accommodating large test equipment. The sub-laboratory occupies, on two floors under a total roof height of approximately 25 feet, most of the remaining space. At the second floor level there is an observation mezzanine overlooking the high voltage area. It is intended that this high voltage laboratory will serve both industrial needs as well as educational purposes. Equipment plans are as follows:

Power Frequency High Voltage

A supply voltage variable up to 2300 volts at 60 cycles will be available from a 230-kva. alternator driven by a d-c motor. Installation of this apparatus is now nearing completion. Three transformers rated at 55-kv. are available, and industry is expected to donate another of approximately 200 to 300-kv. rating.

It is expected that a Schering bridge will be built during the summer of 1958. A Hartmann and Braun 250-kv. compressed gas capacitator has been obtained for the "standard" in this bridge circuit. Facilities for measurement of ratio and phase angle of potential transformers will also be included. It is intended that measurements of radio interference from high voltage apparatus will also be possible.

High Voltage Direct Current

Cascade rectifier equipment capable of an output of 440-kv. total, 220-kv to ground, is available, but requires suitable primary control and metering equipment. This is expected to be of very considerable value in insulation research.

Impulse Testing

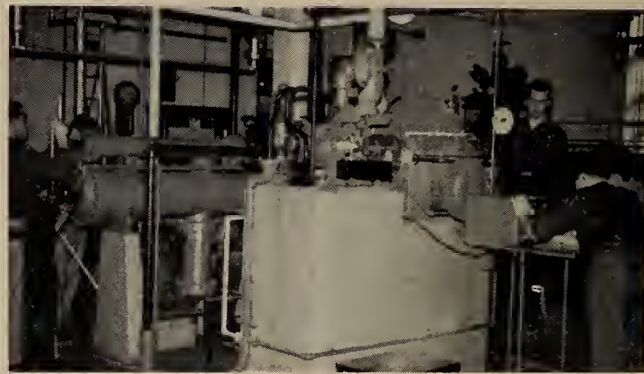
The building design will permit an installation of the order of 2,000-kv. rating. No equipment is as yet available, but it is expected that many of the components required for the construction of a generator will be donated by manufacturers. The same applies to the necessary high voltage high speed oscillograph.

To sum up, the development of the high voltage laboratory into a well equipped operating unit is expected to extend over a period of several years, and considerable aid from industry in the provision of apparatus and components is anticipated. A course in high voltage technology, at the graduate level, should be available for the 1958-59 session.

Extensions to Laboratories

Mechanical, civil, and electrical laboratories are to be expanded. Sketch plans are presently under way for a 70-foot by 107-foot one-storey extension to the end of the existing mechanical engineering laboratory. Sketch plans are also under way for a 70-foot by 107-foot second and third storey extension to the existing one-storey civil engineering materials testing laboratory. It is hoped that these additional floor areas will be available for occupancy by the open-

Group in electrical laboratory, Manitoba.



Steam turbine test in mechanical laboratory.

ing of the fall term in 1958. Temporarily, it is planned to use much of the new space for classrooms.

Equipment which has been added recently in civil engineering includes: a Baldwin 30,000-pound universal testing machine; Baldwin portable dial strain indicator using a large clock dial for easy group visibility; two Baldwin SR-4 strain gauge type load application cells; a Wilde geodetic transit reading directly to 1.0 second; and a miniature compaction apparatus for the soils laboratory.

Equipment added during 1957 in mechanical engineering consists of: a two-stroke, 75-hp. General Motors diesel engine; four-stroke, 225-hp. Caterpillar diesel engine; a Heenan & Froude dynamometer to absorb the latter hp.; and, with equipment donated by Honeywell Control, a set-up for carrying on experiments in automatic control.

Recent equipment additions to the electrical laboratory are an educational amplidyne set; a motor-generator set; a precision Kelvin-Wheatsone bridge; and various measurement standards. A very fine donation of carrier and high frequency communication equipment was received from industry in 1957.

Electronic Computer

The University of Manitoba received a donation of $32,000 in January from the Pioneer Electric Company of Winnipeg, which will provide an electronic computer.

The computer, to be purchased from the Bendix Corporation, will be used to solve involved calculations by the mathematics, physics and engineering faculties. It will be installed by April, probably in the engineering building, to be ready for use by the fall term.

Elections and Transfers

A number of applications were presented for consideration and on the recommendation of the Admission Committee, the following elections and transfers were effected at a meeting of Council on March 1, 1958.

Members: R. M. Allemang, Peterborough; M. K. Baillargeon, Cardinal; G. K. Barkovits, Montreal; H. F. Bartram, Montreal; L. M. Bell, Morrisburg; R. A. Campbell, Montreal; H. Chochlewicz, Toronto; G. K. Cranna, Welland; M. A. Dau, Montreal; J. Davis, Vancouver; A. J. Dewdney, Preston; R. E. Evans, Montreal; A. E. H. Fair, Boston; H. H. Fickel, Victoria; A. Foster, Brockville; G. J. Gelencser, Montreal; G. Goodwin, Ottawa; R. B. Hamel, Montreal; A. S. Hayes, Montreal; A. Hedefine, New York; J. G. Hodges, Sudbury; J. W. Hodgins, Hamilton; D. T. MacLachlan, Montreal; R. N. McLellan, Vancouver; J. Paszkiewicz, Montreal; T. B. Peart, Calgary; R. L. Raikes, Toronto; J. M. Richardson, Peterborough; R. C. Sadler, Toronto; D. Silverman, Granby; D. M. Sloan, Montreal; W. Strok, Vernon; I. T. Szametz, Kitimat; R. M. Trim, London, England; H. J. Vale, Montreal; J. F. White, Montreal.

Juniors: C. Y. Chang, Toronto; D. R. Coates, Montreal; J. E. Dowell, Sept Iles; T. R. Fredriksen, London; W. G. Geddes, Montreal; D. W. Parks, Toronto; A. Shewchenko, Montreal; K. G. Tamberg, Toronto.

Junior to Member: J. S. R. Beck, Hamilton; R. E. Burridge, Fredericton; R. K. Coates, Banff; R. P. Crawford, Copper Cliff; E. W. Hutchinson, Point Ann; B. C. Kaulback, Montreal; N. W. Kuster, Fort William; J. S. Kyle, Peterborough; P. E. Poisson, Montreal; G. C. Willeumier, Vancouver.

STUDENTS ADMITTED:

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(Continued on page 147)

THIRTY-FIVE YEARS AGO

Comment on the Journal of April, 1923

The April 1923 issue of *The Engineering Journal* introduced the incoming president for the year, Walter J. Francis. In partnership with Frederick B. Brown, C.E., in 1910, he formed the consulting firm of Walter J. Francis and Co., and after reporting on many power developments and on municipal undertakings in various Canadian cities, in 1922 he became consulting engineer to the Royal Commission respecting the activities of the Hydro Electric Commission of Ontario. He played a prominent role in Institute affairs, and was instrumental in establishing the Montreal Branch, of which he was the first chairman.

Five papers were published in this issue, of which the subjects were: Design and Economics of City Refuse Destructors; The Fuel Situation in Canada; Electrons, Atoms and the Ether; The Cost of Industrial Power; and Electricity for Heating Buildings. In the last, a summary of conclusions by the author, G. Gordon Gale, vice-president and manager, Hull Electric Co., were given as follows: "The direct use of hydro electricity for heating is not desirable to the individual because the cost is too high. It is not possible to supply the community because there is not enough to supply everyone, nor is it in the interest of the country because electric power has another and more useful sphere."

Under Branch News, the Border Cities Branch recorded an address by D. A. Molitor, M.E.I.C., in which he described studies of the location for the Panama Canal, its construction and commercial advantages. The Hamilton Branch reported on a debate on the railway situation in that city, in which many prominent members took part. E. G. Cameron, M.E.I.C., chief engineer, Saint John Dry Dock and Shipbuilding Co., addressed the Saint John Branch regarding the construction of the Courtenay Bay breakwater and the 1150-ft. long drydock at Saint John. The London Branch heard H. B. R. Craig, M.E.I.C., in an address on harbour engineering. At Halifax, the Branch reported addresses by F. W. W. Doane, city engineer, on problems of the municipal engineer, and by W. B. MacKay on Recent Developments in Ventilation.

The Ottawa Branch recorded three papers, one on "Mining in Ontario," by John McLeish, director of the Mine Branch, who told the meeting that during the past five years northern Ontario had contributed over 95 per cent of the metal mineral production of Canada. J. D. Craig, M.E.I.C., Commander of the Canadian Arctic Expedition of 1922, predicted the Arctic archipeligo, might become a prized territory if the resources were developed. A third speaker was Major E. O. Wheeler, M.C., R.E., a member of the famous expedition which had reached an altitude of over 27,000 feet in an attempt to scale Mount Everest.

The Winnipeg Branch heard a paper on Three-Wire Distribution as Applied to Electric Traction, by W. Nelson Smith, M.E.I.C., while James Stewart of the late grain board addressed a second meeting on The Marketing of Grain. The Calgary Branch heard a talk on Coal Formations in Alberta by Lt. Col. F. M. Steele, D.S.O., M.E.I.C. The Edmonton Branch heard a paper on Alberta Highways by H. G. Dinsdale, M.E.I.C., and an address by Dr. Wyatt of the University of Alberta on the soil survey of the province.

The Montreal Branch had set up a committee to investigate the local coal situation. Lectures were given on the construction of dams by Major J. A. Brace, M.E.I.C., with particular reference to the Gouin Dam; and by J. L. Busfield, M.E.I.C., on water power resources of Manitoba, with illustrations of the Great Falls development on the Winnipeg river. An address was given at the Institute headquarters by H. J. Vennes of the Northern Electric Company, with another by Professor A. S. Eve at his home on Mountain Street. Both addresses were heard at both places through loud speakers. This experiment to show how a human voice could be taken apart, sent in waves to another place; then reassembled and distributed in all its original characteristics was a unique event.

At its Branch meeting, the Toronto Branch reported a membership of 650. Subjects of papers given included Methods of Purifying Water Supplies, by R. L. Dobbin, M.E.I.C; Electrification of Railways, by A. L. M. Mudge, M.E.I.C., and Valuation of Railways, by Arthur Crumpton, M.E.I.C. The Kingston Branch heard papers on Plant Used in Concrete Road Construction, by Professor L. Malcolm, M.E.I.C., of Queen's, and a paper by Norman Gibson, M.E.I.C., hydraulic engineer of Niagara Falls, N.Y., on the application of his new method of measurement of water flow in penstocks.

H. G. C.

Elections and Transfers

(Continued from page 146)

University of Manitoba: A. W. Bartnicki, T. H. Chan, M. L. Daiter, H. Derksen, K. Geddes, F. J. Greeves, R. Harder, P. S. Jawanda, R. A. Madder, A. Mazur.

Canadian Services College: W. J. Carter, C. E. Hooker, C. F. Hunter, C. W. Kautz, A. M. Kipiniak, J. B. Klassen, R. J. Lawson, P. Scholz, R. C. Smith, B. R. Waters.

Queen's University: R. R. Faddick, T. J. Flynn, D. E. Forrester, R. I. Kingston, J. G. McCubbin, T. Mostoury, W. D. Robertson, R. H. Thicke.

Mount Allison University: R. E. Gale, K. W. MacNeil, D. L. McKeown, R. W. Newcomb, M. I. Townsend, P. J. Vanier, C. Wan, S. W. Wiggs.

University of New Brunswick: C. C. Chen, L. Goguen, M. Huard, M. R. McKeil, F. J. Rooney, G. A. Rushton.

McGill University: L. Baltas, J. C. Danis, L. Dery, P. A. H. Dufays, D. S. Edelberg, B. Houde.

University of Toronto: E. Brundrett, C. E. Capes, G. G. Cherrington, R. E. Kadlec, J. D. H. Martin, C. H. McClellan.

Nova Scotia Technical College: D. J. Fox, W. S. Wilkinson, D. V. Williams.

Dalhousie University: W. F. Emery, D. A. Fraser, D. L. Whalen.

University of Western Ontario: H. G. Beretta, J. M. Dixon, T. A. McCleneghan.

University of Alberta: G. F. Buck.

Acadia University: J. G. Smith.

Memorial University: G. J. Moores.

University of Ottawa: P. Y. H. Ho.

University of Detroit: N. J. Antaya.

Mass. Inst. of Technology: R. L. Turner.

Graduates: W. T. Cole, B.Sc., (Civil), Queen's University 1957; J. M. Y. Masse, B.Sc. (Mech.) Laval University, 1957.

Applications through Associations:

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

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Junior to Member: D. L. E. Marcoux, J. B. Stobbs; **Student to Junior:** N. L. King.

NEW BRUNSWICK

Member: D. C. McLeod; **Junior to Member:** D. C. MacCallum, J. P. Mooney.

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Sec.-Treas., C. S. Landon, Room 418—265 Portage Ave., Winnipeg 2, Man.

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Secretary, G. H. Rogers, c/o Engineering Institute of Canada, 160 Eglinton Ave. E., Toronto.

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Brigadier General Sir Alexander Gibb, Hon. M.E.I.C., noted engineer and former adviser to the Canadian government on seaport development died at Hartley Wintney, England on January 21, 1958.

Born at Broughty Ferry, Scotland, on February 12, 1872, Alexander Gibb represented the fifth generation in direct succession, of civil engineers. He was educated at Rugby School, England, and at University College, London, before going on to engineering studies as an articled pupil with the office of Sir John Wolfe Barry and H. M. Brunel.

In 1900 Gibb left Wolfe Barry to assist his father, a member of the firm of Easton Gibb and Company. During the next sixteen years one of his greatest contracts was the naval dockyard at Rosyth, of which it was publicly announced at the Institution of Civil Engineers that "it was due to the sagacity, fortitude, and enthusiasm of Sir Alexander Gibb that the works had been completed in time to be of immense use to the Fleet during the vital periods of the war."

In 1916 he was appointed chief engineer, ports construction, to the British armies in France. Later he became civil engineer in chief, Admiralty, concerned with measures to counter the U-boat menace. Gibb was granted a C.B. for his services to the armies in France and a K.B.E. on appointment to the Admiralty. His work there was recognized by advancement to G.B.E.

In 1919 Sir Eric Geddes, an old associate, then minister of transport, appointed Sir Alexander Gibb director-general of civil engineering, with the responsibility of creating a new department in a new ministry while dealing with a variety of problems connected with communications in the British Isles.

In 1921, opening a consulting engineering practice in London he set up the two-room office in Victoria Street, later to grow into the firm of Sir Alexander Gibb and Partners, Queen Anne's Lodge, Westminster, which historic eighteenth century building is its headquarters today. Branch offices are located in Britain and overseas, as well as an associate, Sir Alexander Gibb and Partner (Africa) at Nairobi.

Later, during World War II, poor health forced him into semi-retirement. A son, Michael Gibb has become a partner in the firm.

Sir Alexander Gibb was an associate member and member of the Institution of Civil Engineers for more than sixty years and president of the organization in 1936-7.

He joined the Institute in 1932 as a Member. He was named to Honorary membership in 1937.

Dr. T. H. Hogg, M.E.I.C., noted consulting engineer and former chairman of the Hydro-Electric Commission of Ontario, died at Toronto, on February 24, 1958.

Thomas H. Hogg was born at Chippawa, Ontario on April 20, 1884. He received his education at the Niagara Falls Collegiate Institute and the University of Toronto. He graduated from the latter institution in 1907 with the degree B.A.Sc. in civil engineering. He was employed with the Ontario Power Company, Niagara Falls, in various capacities, from his undergraduate days of 1902 until 1911. After his graduation his field of work broadened to include developments in New York State. A brief interlude of editorial work created contacts for him with engineers in many fields at a time noted for rapid material progress throughout Canada.

Dr. T. H. Hogg, M.E.I.C

In 1913 Dr. Hogg joined the staff of the Hydro-Electric Power Commission of Ontario as an assistant hydraulic engineer, and in succeeding years filled the position of chief hydraulic engineer, chief engineer and finally, chairman and chief engineer of the Commission in 1927. He retired in 1947 and became engaged in the work of consultant to the Federal government on hydraulic matters and western water problems.

Dr. Hogg served as a member of the Senate of the University of Toronto, representing graduates in applied science and engineering for twenty-five years.

He was awarded the honorary degree of D. Eng. from that university in 1927.

He was in 1948 named winner of the Sir John Kennedy Medal of the Engineering Institute. The citation which accompanied the award read "Thomas Henry Hogg was born close to the site where he was to build for himself a record as a great engineer and a great citizen. Chippawa and the Niagara Falls area were the locale for many important events of his life from his birth to his greatest engineering achievement."

Dr. Hogg held directorships in a number of organizations including the Chartered Trust Company and the Brazilian Traction, Light and Power Company Limited.

Dr. Hogg joined the Institute as a Student in 1904, transferred to Associate member in 1912, and to Member in 1922. He attained Life membership in 1948.

George Edward Cole, M.E.I.C., former director of the Manitoba Mines Branch and past-president of the Canadian Institute of Mining and Metallurgy, died at Winnipeg on December 11, 1957.

Born at Alymer, Que., on December 2, 1879, Mr. Cole was a graduate of McGill University. He received a B.A. degree in 1902, and qualified for the degree, B.Sc. in mining, at that university, four years later.

A period of mining engineering with numerous concerns marked his early professional experience.

Enlisting in the 159th Overseas Battalion, Canadian Expeditionary Force in 1915, he later transferred to the Canadian Engineers, serving in France and Belgium. In 1919, returned to Canada, he was employed as a mining instructor at the Haileybury School of Mines, Haileybury, Ont., by the Department of Soldiers' Civil Re-establishment, in training returned soldiers in mining, milling and prospecting work. Continuing his army affiliations in peacetime he commanded the Algonquin Rifles at Winnipeg, retiring with the rank of lieutenant-colonel in 1932.

Mr. Cole was in 1921 appointed to the department of mines, Province of Ontario, in the capacity of inspector of mines. He accepted office with the Province of Manitoba as chief inspector of mines in 1928. The appointment came at a time when preparations were underway for the control of natural resources, previously a Dominion government concern, to be assumed by that province. As a result of this move, Mr. Cole was named chief inspector of the department of mines and resources. Promoted to director of the mines branch in 1930, he continued this work until his retirement in 1945.

In 1941-42 he was loaned to the Federal government to serve with the Wartime Bureau of Technical Personnel, Ottawa.

He became a member of the Canadian Institute of Mining and Metallurgy in 1914, was elected vice-president for 1933-34, and president for 1936-37. He became a life member in 1945. Elected president of the Association of Professional Engineers of Manitoba in 1941, he was again asked to serve that body in 1944. He was active as a Freemason.

Mr. Cole joined the Engineering Institute as a Student member in 1905. He transferred to Associate membership in 1912, and to member in 1940. He attained life membership in the organization in 1946.

W. G. Milne, M.E.I.C., retired managing director of the N. Slater Company Limited, Hamilton, Ont., died in that city on November 27, 1957.

Winford Gladstone Milne was born on June 16, 1877, at Scarborough, Ontario, and studied engineering at the School of Practical Science of the University of Toronto, from 1898 to 1902. Before graduating he gained experience with the Lindsay Light and Power Company and the W. H. Johnston Electric Company. He entered the service of the Hamilton Bridge Works drafting department in 1909, and the following year became plant engineer, which post he held for eleven years.

Joining the N. Slater Company in 1920, Mr. Milne's first responsibility was that of works superintendent and later chief engineer and managing director. Mr. Milne held patents to many electrical and mechanical items.

Retiring two years ago, he was a director of the firm until his death.

Mr. Milne joined the Institute as an Associate member in 1919; and transferred to member in 1935. He became a life member in 1949.

W. G. Milne, M.E.I.C.

C. P. Haltalin, M.E.I.C., manager of the operating division of the Winnipeg Electric Company, Winnipeg, Man., died in that city on February 7, 1958.

Born at Winnipeg, Man., on December 28, 1906, Clifford Paul Haltalin was educated at the Daniel McIntyre Collegiate and at the University of Manitoba. He was awarded a B.Sc. degree in electrical engineering in 1929. Shortly after graduation he joined the Winnipeg Electric Company and advanced as junior engineer, assistant electrical engineer, supervisory engineer, and chief electrical engineer. In 1953 he was appointed manager of the operating division.

Mr. Haltalin was chairman of the Winnipeg Branch of the Institute in 1945 and represented the Winnipeg Branch of the Institute as Councillor in 1954.

He joined the Institute as a Student member in 1927; transferred to Associate member in 1934 and to Member in 1940.

A. M. Reid, M.E.I.C., district engineer with the Department of Public Works, Province of Alberta, died at Edmonton on January 28, 1958.

Alexander MacLaren Reid was born at Glasserton, Whithorn, Wigtownshire, Scotland, on December 21, 1895. He was educated at Whithorn High Grade School, and then served with the British Army and the King's Own Scottish Borderers during World War I. He later returned to Glasgow and underwent private tuition and technical evening classes in order to study engineering.

His first post outside the armed forces was an assistant to the county surveyors at Stranraer, Scotland. Leaving Great Britain in 1921, he accepted employment with the Anglo-Persian Oil Company to assist in a road-building project in Persia. He remained in the service of this organization for a period of six and a half years. The next phase of his professional career brought him to Canada where he joined the firm of E.G.M. Cape and Company, engineers and contractors, Montreal. The following year he first became associated with the Department of Public Works, Province of Alberta, Edmonton, as an instrumentman.

Named resident engineer on the survey and construction of the main highways in 1930, he was a few years later associated with the Alberta Relief Commission, in the administration of relief and relief work in the Alberta drouth areas during the depression years. Later he was appointed resident engineer on the main highway branch at Edmonton, and district engineer at St. Paul, Alta.

F. C. Kresz, M.E.I.C.

Mr. Reid joined the Institute as an Associate Member in 1939, transferred to Member in 1940.

Francis Charles Kresz, M.E.I.C., consulting engineer, associated with the firm of R. P. Allsop and Associates Ltd., Toronto, a prominent member of the Hungarian community of Toronto and founder of the Canadian Hungarian Professional Engineers' Society died at Toronto on June 16, 1957.

Mr. Kresz was born at Budapest, Hungary on July 11, 1883. He attended the Royal Technical University at Budapest and graduated in mechanical and electrical engineering in 1905. Thereupon he joined the Belgian branch of the world-wide Koerting Company. In 1909 he was called to the Austrian office of the firm at Vienna which move was followed a short time later by his appointment as export manager for the Balkans. Before the first World War, the troublesome years of the two Balkan Wars, he worked in this area, with headquarters at Sofia. Also in that period of his career he was recalled to Vienna and given the new assignment of re-organizing the Hungarian branch of the Koerting Company, developing the company into the foremost of its kind in Hungary. He became its president in 1935. After the break-up of the Hungarian-Austrian empire, Mr. Kresz gradually acquired ownership of the Hungarian Koerting Company. In 1948, due to Communist influence he was forced to abandon his claim to the company in which he had taken so large a part. Arriving in Canada later that year, he worked with the firm of A. Brittain and Associates Limited.

The Canadian Hungarian Professional Engineers' Society, of which he was the founder, today boasts a membership of 150 persons.

Mr. Kresz joined the Institute as a member in 1952.

Alfred Joseph Altrogge, M.E.I.C., district engineer with the Department of Highways, at Saskatoon, Sask., died suddenly on January 20, 1958.

Mr. Altrogge was born at St. Benedict, Sask., on September 26, 1926. He attended St. Peter's College, Muenster, Sask., in 1943 and 1944. He enrolled at the University of Saskatchewan as an engineering student in 1945. Gaining experience during vacation time, he worked with the Department of Mines and Resources, Ottawa, as a surveyor on the Alaska Highway; with the Hudson Bay Mining and Smelting Company at Flin Flon, Man., and with the Department of Highways at Regina. Mr. Altrogge graduated with a B.Sc. degree in civil engineering in 1949. Since 1950 he had been employed with the Province of Saskatchewan in the capacity he served at the time of his death.

Mr. Altrogge joined the Engineering Institute as a Member in 1952.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

British Columbia

The B.C. Electric Strike

(From "News of the Engineering Profession", published by The Association of Professional Engineers of B.C.)

Criticism which has been expressed in certain quarters concerning the efforts of professional engineers of the B.C. Electric staff to maintain essential electrical services to the public is unfounded and unfair, according to J. A. Merchant, P.Eng, registrar of the Association of Professional Engineers of B.C.

All professional engineers subscribe to a strict code of ethics, which specifies that their prime responsibility is to the public, and secondly their employer. This principle of professional responsibility precludes strike action as a means of enforcing group demands. It is the reason that, in common with other learned professions, they are specifically exempted from the provisions of the Labour Relations Act. Their sole ethical consideration must be fulfillment of the public trust imposed upon them by the nature of their duties.

Public confidence in the engineering profession is based upon the knowledge that so long as an engineer occupies a position of responsibility, all the obligations of that position will be faithfully carried out without regard to any other consideration whatsoever.

His only relief from that responsibility would be to resign his position. In the case of a public utility, when interruption of electrical services would mean not only inconvenience but actual hardship and danger to the public, he would not be justified in abandoning his post even by resignation.

The responsibility of the professional engineers employed by a public utility is to provide essential electrical services to the public, with or without the assistance of other personnel. It is hoped that the public will appreciate that the position of professional engineers in the present wage controversy is based upon a deeply rooted ethical principle which is primarily designed to insure that whatever a professional engineer undertakes to do he must faithfully perform.

NOVA SCOTIA

Annual elections held

L. D. Wickshire, of Liverpool, N.S., engineer of the Mersey Paper Company Limited, has been elected president of the Association of Professional Engineers of Nova Scotia. J. D. Kline, of Halifax, newly appointed general manager of the Public Service Commission, was elected vice-president of the Association.

The following members have been elected councillors for 1958-59: G. D. Mader, G. H. Dunphy, O. N. Mann, and J. B. Ternan, all of Halifax; B. N. Cain, Wolfville; J. R. Cameron, Milford; A. B. Rossetti, Sydney, and C. S. Williams, Antigonish.

Mr. Wickwire is a graduate of Colchester County Academy, Dalhousie University and the Nova Scotia Technical College. He served overseas with the R.C.A.F. and was commanding officer of the Air Force depot at Gander, Nfld., following service as chief engineer at the Scoudouc, N.B. base. He has served the Association in numerous capacities including those of councillor and vice-president.

L. D. Wickwire, P.ENG.

Mr. Kline is a graduate of St. Mary's High School, St. Mary's University and the Nova Scotia Technical College. He was appointed manager of the Public Service Commission following appointments as designer engineer, chief engineer and assistant manager. He served the Association for a period of ten years as secretary-treasurer, followed by a period as councillor.

ONTARIO

Canadian industry has been guilty of misemployment of its professional engineering manpower, and this has been the major reason for the so-called shortage of engineers, T. M. Medland, executive director of the Association of Professional Engineers of Ontario declares in his annual report.

"There has never been a crippling shortage of professional engineers in this country, but we have been guilty of misemployment of the engineering brains that have been available," he said.

"The major need at the moment is for industry to provide an atmosphere in which our engineers may grow professionally—to provide them with technicians and clerical assistance that will enable the engineer to have time to think and to create," Col. Medland points out.

"I suggest that our national life is being threatened—not by sputniks or I.C.B.M.s (intercontinental ballistics missiles) but by the fate of our export trade.

"The answer to this is increased productivity and new, purely-Canadian products. More research is required and more time for professional engineers to think and to create."

Earlier in his report, Col. Medland noted that of the 1,731 persons admitted to the profession in Ontario last year, 46% received their education outside of Canada. He also pointed out that of 563 applications for registration dealt with by the Executive Council on Jan. 31, 35.1% were of Canadian origin and training; 39.9% of Commonwealth origin and training; 2.9% United States, and 22.1% European.

Engineers in the News

Walter G. Pengelley, P.ENG., who since 1951 has been assistant sales manager at Toronto for Canadian Westinghouse Co. Ltd., has been appointed Ontario district manager. Mr. Pengelley graduated in electrical engineering from McGill University and joined Westinghouse in 1911. Engaged in apparatus sales for most of his career he was manager of the company's apparatus division in Toronto for a number of years.

F. A. Pankhurst, P.ENG., of Canada Wire & Cable Co. Ltd., Toronto has relinquished his duties as general works manager of the Leaside plant to take the post of executive representative reporting directly to the president and vice-president. Mr. Pankhurst, who is a graduate of Faraday House, London, Eng., has been with the Canada Wire & Cable Company since 1934.

W. J. McNicol, P.ENG., of the Canadian Westinghouse Co. Ltd., Hamilton, Ont., has been appointed assistant Ontario district manager. A graduate of the University of British Columbia, he joined the Company in 1950 and in 1953 was appointed manager, sales department, turbine division. Two years later he became sales manager for the power products division. Prior to his most recent appointment Mr. McNicol was sales manager for the company's motor generation division at Hamilton.

Gordon E. Marshall, P.ENG., is sales supervisor with Canadian Chromalox Co. Ltd., Toronto. In this capacity he will supervise the company's industrial sales and advertising programs.

Mr. Marshall obtained his degree in electrical engineering in 1951 at the University of Toronto and was formerly with Canadian General Electric Co. Ltd. engineering and manufacturing department of the electrical heating devices division.

D. J. Dudley, P.ENG., who was formerly radio performance and standards engineer with the Canadian National Telegraphs in Toronto, is now employed as a field engineer with the Telechrome Manufacturing Corp., Amityville, Long Island, N.Y.

F. C. Boyd, P.ENG., of the Canadian General Electric Co. Ltd., has recently been appointed systems appraisal engineer in the Civilian Atomic Power Department of the company. In this post he will be responsible for general appraisal of the nuclear systems, evaluation of reactor hazards and preparation of applications for licenses from the Atomic Energy Control Board.

David L. Featherstone, P.ENG., of Dunnville, Ont., has been elected warden of the County of Haldimand, on whose County Council he has served as Dunnville's representative since 1951.

His entry into Town Council of Dunnville was in 1949 and in 1951 he was elected deputy reeve, serving in that capacity until the end of 1954. In 1955 he became reeve, continuing in office during 1956 and 1957. This year he was again elected reeve but under the newly inaugurated two-year term.

While on Council Mr. Featherstone has served continuously as chairman of the public works committee of Dunnville, except for 1953. He has also been on the Haldemand country roads committee and last year was its chairman.

Wesley G. Nilson, P.ENG., has concluded his current assignment at the Atomic Energy of Canada Ltd., Chalk River, Ont., and has returned to the research laboratory of the International Nickel Co. Inc., at Bayonne, N.J.

Peter M. Sandham, P.ENG., of the Royal Canadian Air Force has been promoted to the rank of Squadron Leader. He is a graduate of the University of Toronto and first joined the R.C.A.F. in 1943. Sqdn. Ldr. Sandham is presently construction engineering officer at the R.C.A.F. Station, Cold Lake, Alta.

D. H. Craighead, P.ENG., is principal of the Hamilton Institute of Technology, Hamilton Institute of Technology, Hamilton., Ont., succeeding **C. C. Ashcroft**, P.ENG., who has retired. Prior to assuming the principalship in Hamilton Mr. Craighead was director of studies at the Ryerson Institute of Technology in Toronto.

W. A. Hutchinson, P.ENG., formerly managing director of Preston East Dome Mines, is now general manager of Phelps Dodge Corporation of Canada Ltd., 55 Yonge St., Toronto.

James Ball, P.ENG., **K. N. Craig**, P.ENG., and **K. W. Short**, P.ENG., have announced the formation of the consulting firm of Ball, Craig, Short & Co. Ltd., with offices at 5385 Yonge Street, Toronto. The principals of this firm were formerly chief electrical, mechanical and structural engineers, respectively, with R. M. Way & Co. Ltd., Toronto.

C. T. Carson, P.ENG., president of the Association of Professional Engineers of Ontario.

H. F. Hurlbut, P.ENG., has joined Shea's Winnipeg Brewery Ltd., 137 Colony St., Winnipeg, Man., in the capacity of assistant brewmaster. His previous employment was with the Kiewel Brewing Company in St. Boniface, Man.

C. M. Jackson, P.ENG., who was a staff member of the faculty of electronics technology of the Ryerson Institute of Technology, Toronto, has been transferred to the Hamilton Institute of Technology where he is directing the course in electrical and electronics technology.

T. H. Dobbin, P.ENG., who has been engineer-in-charge of the design and special projects branch in the department of planning and works of the City of Ottawa, has been given the position of deputy director of planning and works of the Corporation.

Mr. Dobbin is a graduate in civil engineering of the University of New Brunswick and prior to going to Ottawa was Commissioner of Works, Sarnia, Ont.

D. L. George Turvey, P.ENG., of Armco Drainage & Metal Products of Canada Ltd., has been assigned the management of sales activities for his firm in the Ottawa and St. Lawrence Valley area. In this connection the company has recently opened a sales branch office in Ottawa and Mr. Turvey has moved from Guelph to Ottawa.

Stanley J. Bullis, P.ENG., has been appointed to the inspection staff of the Ontario Fuel Board for Ottawa. His duties will include the registration of installation contractors and dealers of oil and gas-fired appliances in the area, as well as other enforcement of the Board's legislation.

Theodore Golob, P.ENG., has accepted the position of design engineer and head of the engineering design office of Canadian Trailmobile Ltd., 807 Pharmacy Ave., Scarboro, Ont. His previous employment was with Eastern Steel Products, Preston, Ont.

Bryan J. McKenna, P.ENG., is now living in Montreal and is employed by Dr. P. L. Pratley, P.Eng., consulting engineer, 1117 St. Catherine Street West, Montreal.

J. Owen Dibbs, P.ENG., has left Toronto for Australia, where he has accepted a position as manager of the marketing division of W. D. Scott & Co. Pty. Ltd., management and industrial engineering consultants, 37 Mount St., North Sydney, Australia.

James H. Graham, P.ENG., is now residing in Thetford Mines, Que., where he is assistant to the chief mechanical engineer of the Asbestos Corporation Ltd. He was formerly with the Canadian Locomotive Co. Ltd., in Kingston, Ont.

A. T. Sloane, P.ENG., who formerly was project superintendent with The Gas Machinery Co. (Canada) Ltd., Hamilton, has accepted the position of maintenance superintendent with the North Star Oil Refinery at St. Boniface, Man.

G. Donald McPherson, P.ENG., has recently been appointed to the staff of the Associate Faculties of Waterloo College, Waterloo, Ont., as lecturer.

Mr. McPherson is a '55 graduate of the University of Toronto in engineering physics and in 1957 obtained his Master's degree from Ottawa University, being one of the first graduating class of that university's course in nuclear engineering.

Col. D. F. MacRae, P.ENG., director of industrial research services of the Ontario Research Foundation, Toronto, has gone to Europe for three months as a special industrial consultant to European productivity agencies.

Personals

News of the Personal Activities of Members of the Institute

Dr. R. L. Hearn, M.E.I.C., (B.A.Sc., Toronto, 1913), has been named a director of the British Newfoundland Corporation Ltd. Dr. Hearn was chairman of the Hydro-Electric Commission of Ontario until his resignation in 1957.

Air Vice-Marshall Alan Ferrier, M.E.I.C., (B.Sc., civil, McGill, 1920), retired from the post of assistant secretary general for air navigation with the International Civil Aviation Organization on January 1, 1958. Air Vice-Marshall Ferrier spent eight years with the organization.

Dr. Ira P. Macnab, Hon. M.E.I.C., (B.Sc., mech., N.S.T.C., 1913), president of the Institute in 1951, has retired from the appointment of general manager of the Public Service Commission of Halifax which he has held since 1947.

His professional career began with the Nova Scotia Light and Power Company. Within the next few years he worked with the Riverside Iron Works, Calgary, and the Royal Securities Corporation on the inspection of properties in South America. In 1925 he was named general manager of the Venezuela Power Company. Later he was transferred to the Monterey Railway, Light and Power Company. He returned to Halifax in 1931 to join the Nova Scotia Board of Commissioners of Public Utilities.

Dr. Macnab took part in establishing the Halifax Branch of the Institute.

Dr. I. P. Macnab, M.E.I.C.

J. D. Kline, M.E.I.C.

J. D. Kline, M.E.I.C., (B.Sc., St. Mary's College, 1938; B. Eng., civil, N.S.T.C., 1940), newly elected chairman of the Halifax Branch has been appointed general manager of the Public Service Commission of Halifax, N.S., following the retirement of I. P. Macnab.

After the organization of the Public Service Commission in 1944 Mr. Kline was appointed design engineer. Two years later he became chief engineer and in January 1955 was appointed assistant manager, still retaining his duties as chief engineer.

He is vice-president of the Association of Professional Engineers of Nova Scotia.

H. F. Beique, M.E.I.C.

A. R. Harrington, M.E.I.C.

Henri F. Beique, M.E.I.C., (B.Sc., Sorbonne, 1930; B.A.Sc., elec., 1936), has been appointed vice-president and general manager of the Quebec Power Company and has been elected to the board of directors of the organization. In 1954 he was named assistant general manager. Mr. Beique was first associated with the company in 1937 after a transfer from the Shawinigan Water and Power Company. He also became assistant general manager of the Quebec Railway, Light and Power Company in 1954.

A. R. Harrington, M.E.I.C., (B.Eng. elec., Nova Scotia Technical College, 1936), has been appointed manager of the Nova Scotia Light and Power Company, Limited, and its subsidiaries. Mr. Harrington has held the position of assistant manager since 1951 and has been employed by Nova Scotia Light and Power Company Limited since 1936.

James T. Cawley, M.E.I.C., (B.A.Sc., mining, Toronto, 1943), deputy minister of mineral resources, Province of Saskatchewan, has been named petroleum adviser on the United Nations technical assistance mission to Pakistan. The appointment followed a request for his

On the Job from

UNIQUE SEAWAY PROJECT is the permanent raising of the southern end of Jacques Cartier Bridge, Montreal, and the replacement of one span without interrupting vehicular traffic. This will provide a minimum clearance of 120 feet for shipping in the seaway canal.

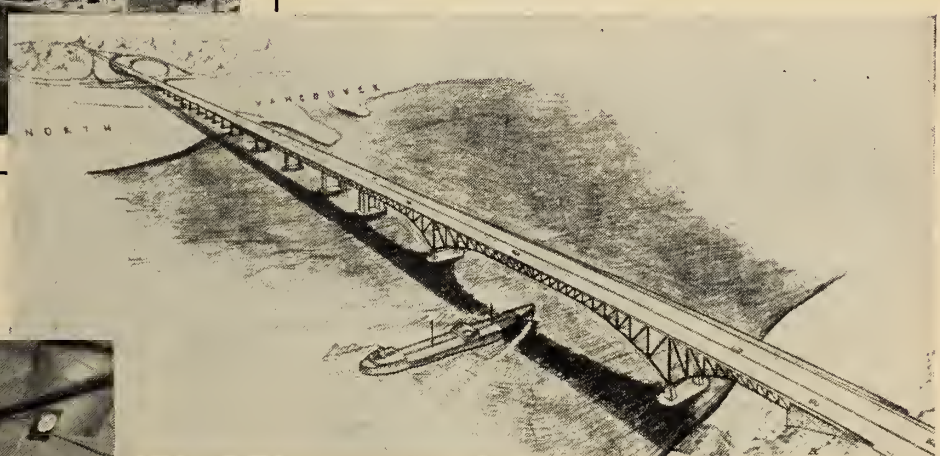
MODERN TREND IN CRANES. This completely enclosed 300-ton gantry crane—the largest ever built in Canada—was designed and fabricated by Dominion Bridge for the Canadian half of the St. Lawrence Power Project. Photo courtesy Ontario Hydro

INTERESTING PATTERN is woven by these conveyor tubes installed at Consolidated Denison Mines Ltd. in Blind River region of Northern Ontario. They were constructed by Dominion Bridge which also supplied structural steelwork for many other uranium mines in this booming area.

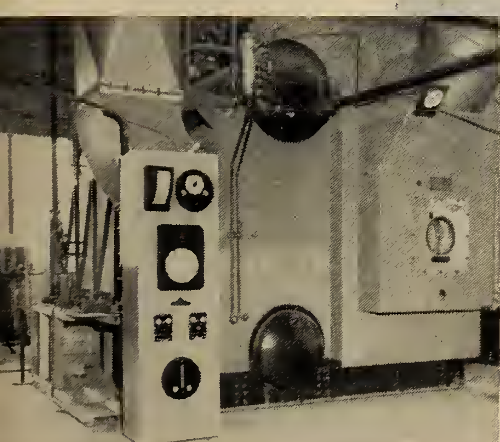
Coast to Coast

From coast to coast, Dominion Bridge is solving engineering problems in every major industry. Our four years' expansion programme is already well advanced—thus enabling us to serve even better the increasing industrial needs of a growing country.

17-STOREY ADDITION. The Royal York Hotel, Toronto. The largest in the Commonwealth, this structure is being further expanded by a 17-storey 400-room addition shown at right. Altogether some 20,000 tons of steel have been fabricated and erected by Dominion Bridge for this project.



ODERN TREND IN BOILERS. ewly developed Dominion Bridge ater tube package unit boilers are op assembled and shipped com- lete to the site ready for connection electrical, water and steam lines.



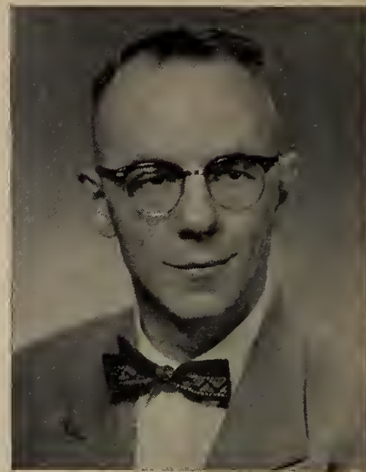
CANTILEVER BRIDGE IN THE WEST. The Second Narrows bridge over Burrard Inlet at Vancouver. 16,600 tons of steelwork will be required for this new 6-lane bridge. With its centre span of 1100 feet, it will be the second longest cantilever bridge in Canada.

DOMINION BRIDGE COMPANY LIMITED. Plants: MONTREAL • OTTAWA • TORONTO • SAULT STE. MARIE • WINNIPEG • CALGARY • VANCOUVER. Assoc. Company Plants: AMHERST, N.S.; Robb Engineering Wks., Ltd. QUEBEC: Eastern Canada Steel & Iron Wks. Ltd. WINNIPEG: Manitoba Bridge & Eng. Wks., Ltd. EDMONTON: Standard Iron & Eng. Wks., Ltd.

Divisions: Structural • Mechanical • Boiler • Platework • Warehouse.

Dominion Bridge Company Limited

• PERSONALS



L. A. Bateman, M.E.I.C.

services made by the Government of Pakistan to the United Nations.

During his three month stay in Asia, Mr. Cawley planned to assist the Pakistan government in the organization of a program of development of the country's oil and natural gas resources.

L. A. Bateman, M.E.I.C., (B.Sc., elec., Manitoba, 1942; M.Sc., elec., Manitoba, 1948), has been elected president of the Association of Professional Engineers of Manitoba for 1958. Formerly with the Winnipeg Hydro-Electric Commission, Mr. Bateman was appointed system planning engineer with the Manitoba Hydro-Electric Board in 1956. He has shown interest in community and engineering affairs for some time and is past-chairman of the electrical section of the Winnipeg Branch of the E.I.C., and is chairman of that Branch for the current year.

I. N. MacKay, M.E.I.C., (B.Eng., mech., McGill, 1935), manager-engineering of the civilian atomic power department of the Canadian General Electric Company Limited, Peterborough, has been named

I. N. MacKay, M.E.I.C.

R. P. Jezek, M.E.I.C.

chairman of the Peterborough Branch of the Institute. Mr. MacKay was for a number of years associated with the National Research Council as superintendent of the design and development branch before transferring to Canadian General Electric Company.

R. P. Jezek, M.E.I.C., civil, Polish Univ. Coll, London, 1949), was appointed port engineer at Montreal Harbour, effective January 1st, 1958.

Mr. Jezek followed his engineering career in Great Britain, then came to Canada where he joined the staff of the National Harbours Board, Montreal Harbour in 1952. Prior to his new appointment, he was in 1957 placed in charge of all capital works.

J. V. Palmer, M.E.I.C., (B.Eng., mech., Nova Scotia Technical College, 1950), of the Dominion Iron and Steel Corporation, Sydney, N.S., has been elected chairman of the Cape Breton Branch of

V. J. Palmer, M.E.I.C.

● PERSONALS

T. P. Hutchinson, M.E.I.C.

the Institute. Promoted to assistant superintendent of yards and docks in 1955; he was previously steel plant supervisor with the organization.

Thos P. Hutchinson, M.E.I.C., (B. Eng., civil, McGill, 1944) has been appointed representative of INFILCO (Canada-Ltd. in Eastern Ontario, Quebec and the Maritime provinces, with headquarters in Montreal.

Mr. Hutchinson has been active in the industrial consultant and construction fields in Ontario and Quebec since 1945, and has been associated with several large Canadian firms on major projects.

David S. Kirkbride, M.E.I.C., (B.Sc., Sask., 1934, M.Sc., Sask., 1937; M.Sc., civil Harvard Univ., 1937), has been named general manager of the "Fabrikoid" division of Canadian Indus- who joined C-I-L in 1937, was prior to this appointment, effective January 1st, assistant general manager of a division with headquarters at New Toronto, Ont.

Martin J. Warren, M.E.I.C., (B.Sc., elec., Manitoba, 1943), of Chain Belt (Canada) Ltd., has been assigned to the duties

M. J. Warren, M.E.I.C.


DUMP

of sales engineer in the Toronto district sales office. Mr. Warren joined his present company in 1956 following a number of years employment in the field of industrial sales.

H. G. E. Rhodes, M.E.I.C., (B.Sc., elec., Manitoba, 1933), of the George A. Fuller Company, has been transferred from New York to the Pittsburgh branch of the organization.

Before moving to the United States in 1956, Mr. Rhodes had been associated with the firm of Morrison, Hershfield, Millman and Huggins, Toronto; in private consulting work; and with the City of Regina, Sask., engineering department.

E. O. Butts, M.E.I.C., (dipl., civil, Loughborough, Eng., 1949), has established a consulting civil engineering practice specializing in site investigation and soil mechanics in Ottawa. The firm operates in association with the Topo Aerial Surveys Company Limited. Mr. Butts was earlier located at Port Hope, Ont., as town engineer, later moved to Ottawa.

H. J. Gordon, M.E.I.C., (B. Eng., civil, McGill, 1933), has been appointed division engineer at Medicine Hat, Alta., for the Canadian Pacific Railway. He held the post of special engineer at Calgary during the past two years, where he was assigned to changes made to the station. He was assistant engineer of track, 1952-1956, at Montreal.

Mr. Gordon has devoted his entire professional career to the Canadian Pacific Railway.

R. K. Hesse, M.E.I.C., (diploma, mech., Dresden, 1932), previously mechanical engineer for North American Cyanamid Limited, Niagara Falls, Ont., is now associated with Provincial Engineering Limited, as production control supervisor. Prior to these appointments Mr. Hesse worked for Slack Bros., in Waterloo, Que.

Harry I. Hamilton, M.E.I.C., (B.Sc., mech., Queen's 1941), has accepted a position with the Aluminum Company of Canada at Arvida, Que. Mr. Hamilton was previously superintendent of the shops department of the Sao Paulo Light and Power Company Limited, at Sao Paulo, Brazil. He was responsible for the administration and supervision of the general shops, from 1953 to 1957. Mr. Hamilton spent a number of years in South America.

Norwood Bartlett, M.E.I.C., (B.Sc., mech., Univ. of Melbourne, 1940), has accepted the post of project engineer for Dominion Wabana Ore Division, in Newfoundland. He was formerly construction engineer with the Foundation Company of Canada Limited at Montreal.

Maurice H. Nelson, M.E.I.C., (B.A.Sc., civil, Toronto, 1950), has left his work at Saskatoon, Sask., as field engineer with the International Water Supply Ltd., and has taken the position of executive vice-president of the firm of Layne Pacific Inc., at Seattle, Wash.

M. D. H. Dickson, M.E.I.C., (B.A., mech., Cambridge, 1946), has relinquished his post with Defence Construction (1951) Ltd., at Suffield Experimental Station, Ralston, Alberta. He is at present associated with T. H. Newton Engineering Ltd., general construction supervision at Toronto.

H. Fealdman, M.E.I.C., (B.A., Cambridge, 1947; M.A., mech. services, Cambridge, 1951), who has for some time been associated with Sprostons (Jamaica) Limited, Kingston, Jamaica, has joined Cadillac Contracting and Development, Ltd., Toronto.

D. H. Evers, M.E.I.C., (B.Eng., civil, McGill, 1949), of the Dominion Bridge Company Limited, has been appointed Alberta sales manager for the firm. He


for industrial trucks of every kind!
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HART BATTERY GENERAL SALES OFFICES AND FACTORY, ST-JOHNS, P. Q., CANADA

● PERSONALS

has been given charge of sales for Dominion Bridge, Calgary, and for Standard Iron and Engineering Works Limited, Edmonton. He was formerly contract sales engineer for the latter firm at Calgary.

D. A. Ferguson, M.E.I.C., (B.Sc., civil, Alberta, 1945), has been named chairman of the board of Underwood, McLellan and Associates, Ltd., at Saskatoon, Sask. He became associated with the firm immediately after his graduation.

Rene A. LeBlanc, M.E.I.C., (B.A.Sc., civil, Ecole Polytechnique, 1946), has been appointed city manager of Dorval, Que., for a four-year term. Prior to this appointment Mr. LeBlanc served as city engineer from mid-1955 to September 1957, and as acting city manager from September to December 1957. Prior to this development in his professional career he was associated with the firm of Wallace and Tiernan, Montreal.

A. F. Bauer, M.E.I.C., (dipl., mech., Tech. Hochschule, Vienna, 1948), has left his post with Canadian Bechtel Corporation, Vancouver, and is now associated with the firm of Goliad Ltd., Calgary, Alta., in the capacity of project engineer. He is working on the gas conservation program with the oil and gas company in the Pembina Field, Alta.

J. T. Dokken, M.E.I.C., (B. Sc., civil, Saskatchewan, 1948), of the Inland Cement Company Limited has been transferred from Saskatoon, Sask., to head office at Edmonton. He joined the firm as a district sales engineer for the province of Saskatchewan in 1957.

G. Koster, M.E.I.C., (civil, Delft, 1947), formerly of the Department of Public Works, Victoria, B.C., has left Vancouver Island and has accepted a position with the Superior Concrete Products Ltd., at Burnaby, B.C.

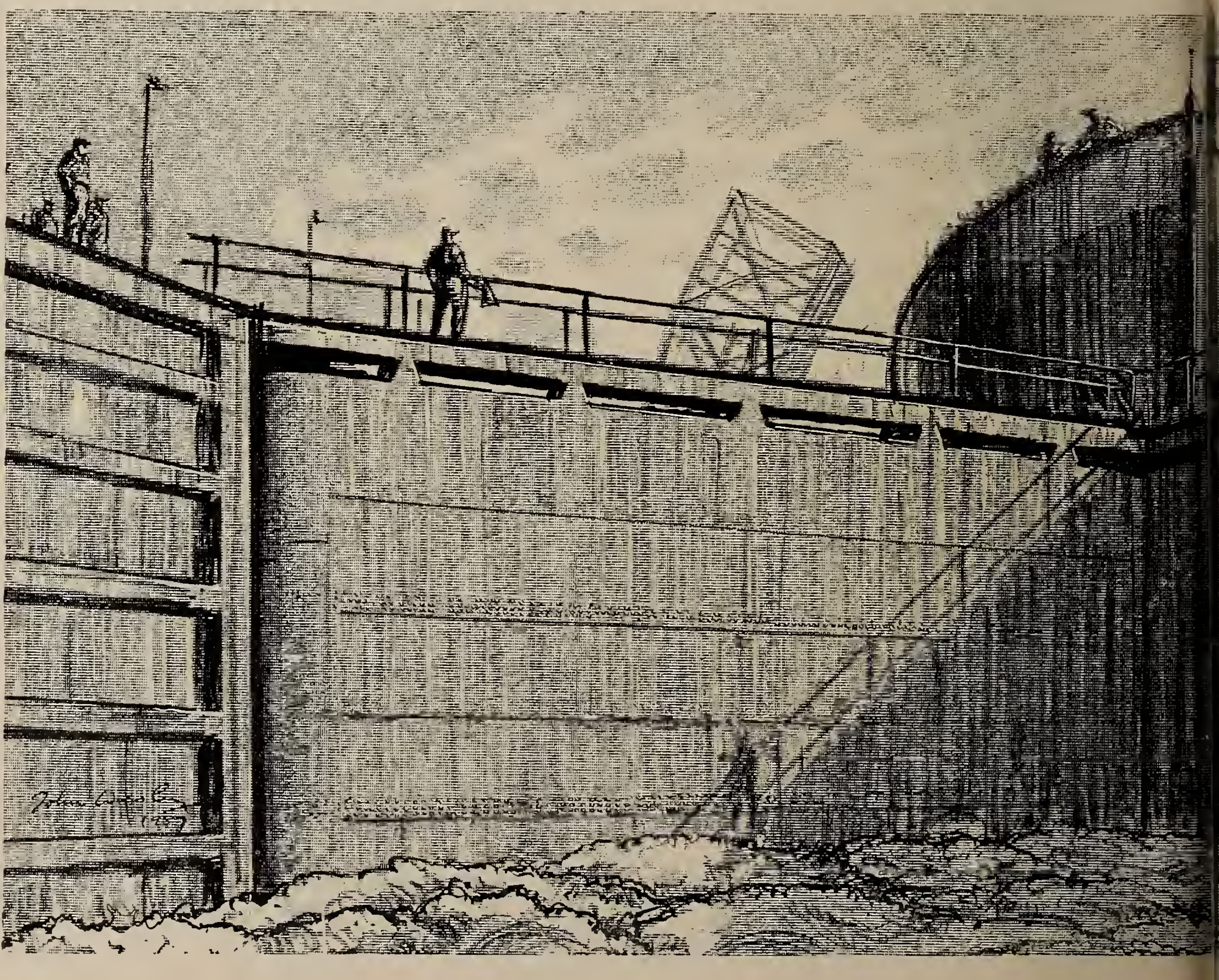
T. H. Dobbin, M.E.I.C., (B.Sc., civil, Univ. of N.B., 1949), of the City of Ottawa, engineering department, has been promoted from engineer in charge of design and special projects branch, department of planning and works, to deputy director, planning and works. He has been devoted to the municipal engineering field since 1950.

A. M. Butt, M.E.I.C., (B. Eng., civil, N.S.T.C., 1946), has assumed responsibility as operations manager of the St. John's, Nfld., plant of Imperial Oil Limited. Previously resident at Halifax, his duties with the company were those of operations analyst, and division engineer, with the St. John's office of the company.

Sean Martyn, M.E.I.C., (B.Eng., civil, University College, Galway, 1947), who was employed with Fraser-Brace Engineering Company Limited in 1956 at Val D'Or, Que., has moved to Newfoundland where he is employed with F. A. Tucker, (Canada) Limited. His work is that of project engineer on the construction of a hydro-electric plant at Nomis Arm, Nfld., for the Newfoundland Light and Power.

E. R. Carpenter, M.E.I.C., B.Sc., mech., Univ. of Sask., 1946), has resigned from his position as building superintendent of Ford Motor Company of Canada in Windsor, Ont., to become director of maintenance for the Winnipeg School District No. 1 in Winnipeg, Man.

Kenneth M. Mote, M.E.I.C., (Higher Nat. Dipl., mech. and production, Central Technical College, 1949), has relinquished the position of plant engineer with the firm of Borg-Wamer Ltd., Letchworth, Herts, England, and has accepted the appointment of chief engi-



• PERSONALS

neer with Aplin and Berrett Ltd., at Yeovil, Somerset, England. In 1952 and 1953 Mr. Mote was in Canada with T.C.F. of Canada Ltd., Cornwall, Ont., as a project engineer.

F. L. Mason, M.E.I.C., (B.Eng., civil, Nova Scotia Technical College, 1950) has left the Department of Highways, Halifax, N.S., and has joined the Eastern Woodworkers Limited, at New Glasgow, N.S. His former post entailed the duties of resident engineer.

P. Langeman, JR.E.I.C.

A. B. Barnes, M.E.I.C., (Higher Nat'l. Cert., elec., Birmingham, 1950), has returned to Canada, to rejoin the De Havilland Aircraft of Canada, Limited, guided missiles division, Toronto, in the capacity of development engineer following a sojourn in the United States. Mr. Barnes was associated with the Boeing Airplane Company of Seattle, as a design engineer for a short time.

Donald B. Dorey, M.E.I.C., (B.Eng., civil, N.S.T.C., 1952), has joined the firm of Leslie R. Fairn and Associates, architects, of Wolfville and Halifax, N.S. Mr. Dorey was employed as a research officer with the division of building research of the National Research Council for five years. During this time he was for three years associated with the building design section, Ottawa. For two years he was officer in charge of the Atlantic regional station at Halifax.

Edward Puchalski, M.E.I.C., (Higher National Cert., mech., S.W. Essex Tech. Coll., 1952), of Calgary is associated with the firm of Angus Butler and Associates Ltd., consulting engineers, in that city. His work involves the design of heating, ventilating and plumbing systems of offices, churches and schools.

Nashmul Huq, M.E.I.C., (dipl, Faraday House, England, 1952), formerly an electrical engineer with the Canadian Pacific Railway Company at Montreal has transferred his services to the Manitoba Power Commission, Brandon, Man., maintenance department.

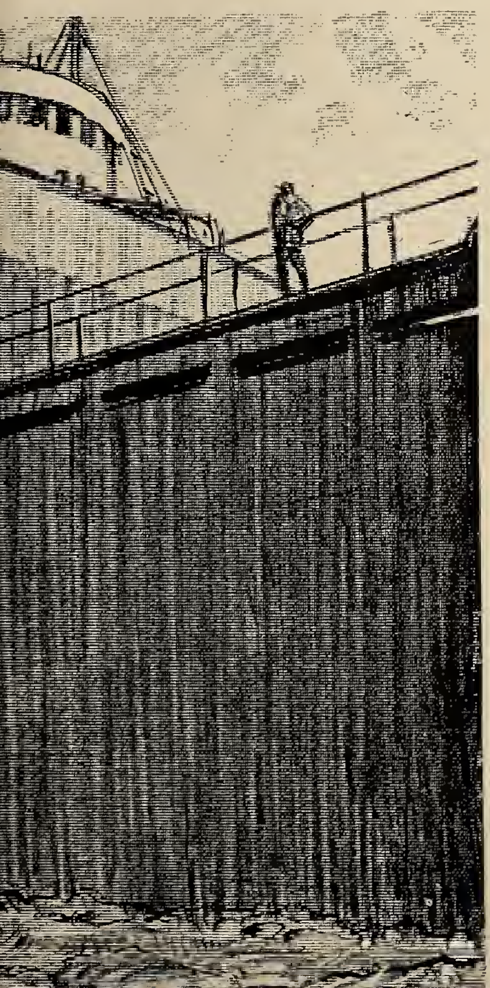
P. Langeman, JR.E.I.C., (B.Sc., civil, Sask., 1955), in Great Britain recently on an Athlone Fellowship, has returned to Canada and is with the Dominion Bridge Company Limited, western division, as a structural designer. Presently he serves as site engineer at Estevan, Sask., on erection of a power station.

Under the fellowship scheme, Mr. Langeman spent one year in London at the Imperial College of Science and Technology doing post graduate work in advanced structures and structural analysis. For the latter work he studied under Dr. A. J. Pippard and Dr. Z. S. Makowski.

During his second year in Britain, he was associated with the Dorman Long Steel organization.

He was awarded the degree D.I.C.

Graham P. Kemp, JR.E.I.C., (B.A.Sc., mech., Univ. of Toronto, 1949), has re-



cently joined the sales engineering staff of the Toronto office of Worthington Canada (1955) Ltd. Mr. Kemp brings to Worthington Canada Ltd. several years experience in design and application of pumping machinery having been previously associated with Dilworth Ewbank, consulting engineers of Toronto, Wm. Kennedy and Sons of Owen Sound and the Smart Turner Company of Hamilton.

M. Nadeau, JR.E.I.C., (B. Eng., civil, McGill, 1949), who was for some time with the Warnock Hersey Company Ltd., in Ville La Salle, has now formed his own company of consulting engineers, M. Nadeau and Associates, in Montreal.

H. N. Halton, JR.E.I.C., (B.A.Sc., mech., U.B.C., 1951; M.Sc., engineering production, Birmingham, 1957), an Athlone Fellowship winner of 1955 has returned to Canada and has accepted a position with the Aluminum Company of Canada as a staff engineer. Mr. Halton took a master's degree in engineering production at the University of Birmingham in 1956. Later he followed a special training course at Vauxhall Motors Limited, at Luton, England.

Mr. Halton, who thoroughly enjoyed his time in England, highly recommends the Athlone Fellowship scheme for engineers.

Lieutenant Commander J. Douglas, R.C.N., JR.E.I.C., (B.A.Sc., elec., U.B.C., 1952), has been transferred from Hamilton, where he was resident naval overseer, to naval headquarters in Ottawa to assume the post of destroyer escort project officer, new construction ships, on the staff of the chief of naval technical services.

F. Cameron Brown, JR.E.I.C., (B.Sc., civil, Queen's, 1950), has recently been appointed development road engineer for the Ontario Department of Highways in Toronto. Prior to this appointment Mr. Brown was assistant municipal engineer, Kingston district.

Ian J. Billington, JR.E.I.C., (B.A.Sc., eng. physics, U.B.C., M.A.Sc., eng. physics, 1951, Ph.D., Univ. of Toronto, 1955), is employed as aerodynamicist for Dilworth Ewbank, consulting engineers. He was formerly associated with the Canadian Westinghouse Company Limited.

A. V. Delcloo, JR.E.I.C., (B.Sc., mech., Univ. of Man., 1950), associated with Dominion Rubber Company Limited since graduation, and formerly assistant sales manager for Montreal, holds the post of sales manager for tires in the Maritime division of the company.

Alan P. Sentance, JR.E.I.C., (B.Sc., Univ. of Toronto, 1948), is employed by Avro Aircraft Limited, in Malton, as senior structures engineer, in the preliminary design office.

C. H. Maartman, JR.E.I.C., (B.A.Sc., civil, Univ. of B.A., 1950). Until recently principal design engineer for the British Columbia Engineering Company Limited, Mr. Maartman has now been named design superintendent of hydro-electric projects.

Keith E. Hunt, JR.E.I.C., (B.Sc., elec., Queen's, 1951), has accepted the position of assistant general superintendent, Grand Trunk Western Railway, C.N.R. at Battle Creek, Michigan.

Mr. Hunt has been with the Canadian National Railways since graduation. In 1956 he was named assistant superintendent of motive power for the company at Montreal and for a time was temporarily on loan to the economics branch of the railroads research and development department for cost control and budget studies.

John K. Cavers, JR.E.I.C., (B.Sc., mech., U.B.C., 1951), district sales manager of Pioneer Electric Limited, in charge of sales of all pioneer products in British

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An actual case →

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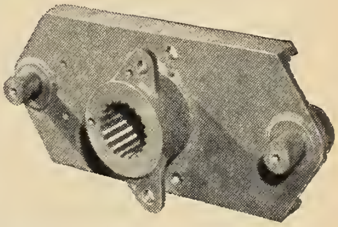

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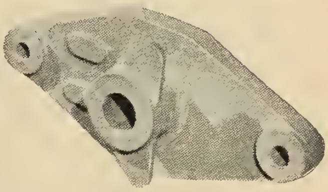

This brake spider for power shovels was originally produced as a weldment. By redesigning it to a steel casting, **cost was reduced 34%, weight 20%.**

Other advantages of castings include: greater strength, better weight distribution, improved appearance.

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• PERSONALS

Columbia, Mr. Cavers was previously associated with Douglas Power Equipment Limited.

John D. Carmichael, JR.E.I.C., (B.A.Sc., U.B.C., 1951), has been appointed assistant production manager of Frank W. Horner Limited, pharmaceuticals, Montreal. Formerly he was associated with Canadian Safety Fuse Co. Ltd., in Brownsburg, Que., and before that with Canadian Industries Limited as engineering assistant.

W. H. R. Gibney, JR.E.I.C., (B.A.Sc., mining, British Columbia, 1950), has been appointed section engineer at the Sullivan Mine of the Consolidated Mining and Smelting Company at Kimberley, B.C. Mr. Gibney has been associated with Consolidated since graduation.

Barclay G. Jones, JR.E.I.C., (B.Sc., mech., Saskatchewan, 1954), of Canadair Limited, has been working in the reactor feasibility group, Montreal, nuclear division at Montreal, since his return to Canada from an Athlone Fellowship awarded him in 1954. Mr. Jones has been professionally associated, under the Fellowship, with the English Electric Company Limited, at Rugby, England, in general mechanical engineering of power plant equipment. The second year of the Fellowship consisted of experience with the Atomic Energy Research Establishment, at Harwell, England. On completion of the Fellowship a further seven months employment was arranged with the reactor division at Harwell. The first four months took the form of reactor-start-up and operation followed by three months on reactor feasibility study.

Adelbert J. Comeau, JR.E.I.C., (B.Eng., elec., N.S.T.C., 1956), has terminated his employment with the Avro Aircraft Limited, Malton, Ont., and has taken a position with the Garrett Manufacturing Company of Canada, Rexdale, Ont., as assistant to the electronics engineer.

R. (Bob) Gauthier, JR.E.I.C., (B.A.Sc., mining, Laval, 1957) who following graduation joined the Aluminum Company of Canada Limited as development engineer, chemical section, at their Wakefield works, was some months ago transferred to the Company's Arvida plant and appointed maintenance engineer, chemical section.

H. E. T. North, JR.E.I.C., (B.Sc., mech., Queen's, 1955), awarded an Athlone Fellowship in 1955, studied aeronautical sciences at the College of Aeronautics, Cranfield, Bed., Eng. On completing the general course, he specialised in economics and production of aircraft and aircraft propulsion.

Returning to Canada, Mr. North spent six weeks with the RCN (R) flying Bell and Sikorsky helicopters before joining the Canadian Pratt and Whitney Aircraft Co. Ltd., Longueuil, Que., as a junior engineer in November 1957.

David M. Robertson, JR.E.I.C., (B.Eng., civil, N.S.T.C., 1956), has returned from Geneva, Switzerland, where he attended Le Centre d'Etudes Industrielles' to join the staff of the industrial engineering department of the Aluminum Company of Canada Limited in Kitimat, B.C.

B. R. Titcomb, JR.E.I.C., (B.Eng., mech., McGill, 1956), who has been in Europe since last summer with the intention of working there for several years, is presently employed as constructor for the Schweizerische Lokomotiv-und Maschinenfabrik in Winterthur, Switzerland.

James Wright, S.E.I.C., (B.Sc., mech., Univ. of Manitoba, 1957), has been appointed silicones sales representative in the Central Ontario district. His previous engineering experience was with the Imperial Oil Company Ltd.

Allan G. Davenport, S.E.I.C., (M.A., Cambridge, M.A.Sc., Univ. of Toronto, 1957), has joined the building structures section of the division of building research at National Research Council, having previously been on the staff of the department of civil engineering at the University of Toronto and also engaged there in graduate research.

B. H. Hamilton, S.E.I.C., (B. Eng., mech., Sask., 1957), is plant engineer, grade I, with the Saskatchewan Power Corporation.

Darrell Allen, S.E.I.C., (B.A.Sc., civil, Univ. of Toronto, 1957), joined H. G. Acres and Company Limited on his graduation as a civil engineer in the hydraulic department of their head office in Niagara Falls.

G. R. Fanjoy, S.E.I.C., (B.Sc., elec., Queen's 1957), has left the Royal Canadian Horse Artillery and has joined the Canadian General Electric Company Limited at its Peterborough works as an electrical engineer.

Harold O. Lacy, S.E.I.C., (B.A.Sc., agri. British Columbia, 1957), formerly of Vancouver, has moved to Ottawa, where he is employed at Central Experimental Farm.

Jean Landriault, S.E.I.C., (B.Eng., mech., McGill, 1955), is employed with Davie Shipbuilding Limited, as a design engineer at Lauzon, Que.


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CONVEYORS


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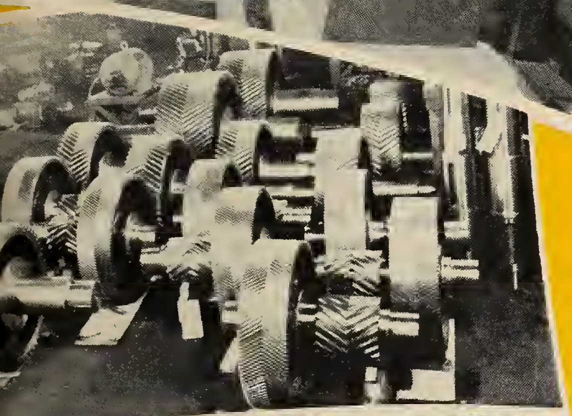
ND CHAIN DRIVES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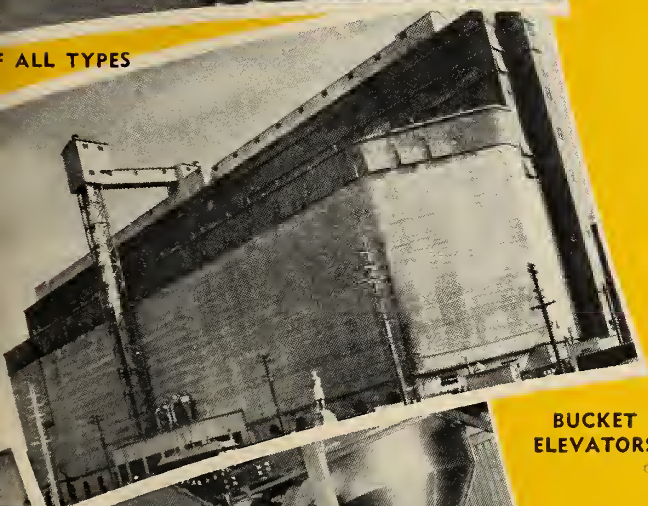
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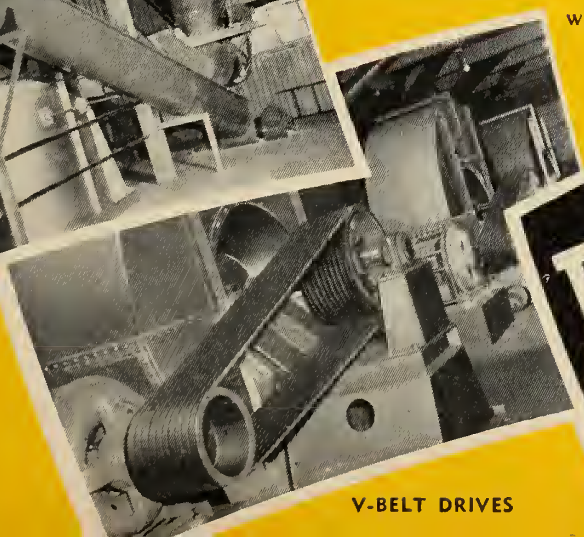
V-BELT DRIVES

NEWS OF THE BRANCHES

Activities of the Forty-Nine Branches of the Institute and abstracts of the papers presented at their meetings

BORDER CITIES

A. W. MALMBERG, JR.E.I.C.,
Branch News Editor

A JOINT MEETING of the Border Cities Branch E.I.C., and the Association of Professional Engineers was held on March 27. A reception and dinner were also enjoyed.

Guest speaker C. T. Carson, president of the A.P.E.O., is the first Windsor resident to be elected president of the Association since J. Clarke Keith held office in 1935. During the intervening years membership in the Association has grown from 1150 to its present force of 16,700.

J. A. McLaren, Eastern region field secretary of the Institute attended the meeting.

BROCKVILLE

W. E. MORDEN, M.E.I.C.,
Branch News Editor

A JOINT DINNER MEETING with the Chemical Institute of Canada on February 28 welcomed J. N. Pryce, president of the Montreal-Ottawa chapter of the Society of Fire Protection Engineers. A member of the Dominion Board of Insurance Underwriters, Mr. Pryce is concerned with the co-ordination of fire protection engineering activities across Canada, and the idea of establishing uniform practices. The scope of operations includes the development and publication of numerous fire protection standards for distribution in Canada as sponsored by the Board fire insurance companies.

Study of the causes of large city fires revealed that the actual extent of damage caused, coincided with predictions outlined in reports prepared by field engineers, with a surprising accuracy. Consequently, surveys were carried out to include all large cities and towns. It is now a well-defined engineering method in which nothing remains to guess work, but is reduced to unquestionable mathematical accuracy.

The survey of a city, a tremendous job, may involve a corps of engineers for several years, as indicated by the fact that two years were required to survey the City of Ottawa. There is also a system of deficiencies, or variance from recognized good standards.

All communities are rated from first class down to tenth class, and basic rates are set accordingly. These are determined by the regional insurance companies and those who contribute to the surveys are known as Board companies.

A highlight of the Border Cities branch activities was the tour of the Canadian Rock Salt Company mine at Ojibway, Ont. More than one hundred branch members and guests saw modern mechanized salt mining operations. A piece of crystalline rock salt was given to each visitor as a souvenir. A delicious lunch was served to all visitors by the Canadian Rock Salt Company in a modern employee lounge after the tour.

CALGARY

FRED L. PERRY, M.E.I.C., *Publicity*

THE SIXTH ANNUAL SLIDE RULE SOIREE of the Calgary Branch was held on February 14 in the main ballroom of the Palliser Hotel. Three hundred and twenty-one members and wives, a sell-out crowd, enjoyed cocktails before dinner, followed by a full evening of dancing and the traditional branch talent show.

This year's production took the form of a "Showboat Revue," written and directed by Jessie Neil and featuring Stan Rokosh as master of ceremonies. In large measure, the success of the show was due to the musical arrangements composed by Roy Price which provided the background music for Joan Smith's spotlight rendition of "The Man I Love." In all, forty-seven members and wives participated as singers, dancers, skit boys and stage hands.

For the most part, the same people who staged the "Pipeline Revue" in 1957, which was repeated at the E.I.C. annual meeting at Banff were stars of the show again this year. In particular, Joan Smith was the same feature singer who stopped the show as "Maime", the girl who very nearly "prevented the pipeline from getting to the east on time."

(for Calgary Branch photo see p. 174)

CORNER BROOK

ERIC R. SKANES, JR.E.I.C.,
Branch News Reporter

AIR SYSTEMS APPLICATION to industry were generally outlined under two main headings, by Ralph Willis, assistant general manager of Ross Engineering of Canada at a meeting of the Corner Brook Branch, February 25, 1958.

Introduced by W. Spurrell, New Brunswick representative for Ross Engineering, Mr. Willis discussed the use of air for human comfort, and for process in plants, factories, etc. Heating, ventilating and cooling were described in relation to human comfort, while drying, baking and dust control were factors for consideration in the use of air for process in plants and factories. Mr. Willis spoke at length on the subject of dust control, dealing with the different methods of separation, and where applicable, dust collection and conveyance. The talk was thoroughly enjoyed by the group and an active discussion period followed. A vote

of thanks was extended by Henry Carter. Adjournment was moved by H. Clarke and seconded by G. P. Hobbs. Twenty-six persons attended the meeting.

EASTERN TOWNSHIPS

JEAN BOURASSA, JR.E.I.C., *Secretary*

A JOINT MEETING of the Eastern Townships Branch and the Corporation of Professional Engineers of Quebec, held at Sherbrooke, Que., on February 7, drew an attendance of more than 90 persons to hear C. A. Peachey, president of the Corporation and general manager of the communications equipment division of the Northern Electric Company Limited, discuss the subject of confederation. Mr. Peachey was introduced by Gaston Masse, meeting chairman, and regional representative of the C.P.E.Q. In his talk, entitled "Plan for Unity", Mr. Peachey reviewed the progress made by the Canadian professional engineering organizations toward confederation. He outlined the history of the Engineering Institute of Canada, the provincial associations, and the formation of the Dominion Council of professional engineers associations. Mr. Peachey also gave an account of the achievement of the various committees at work on the issue and expressed confidence that important results would soon be realized. George M. Dick, Institute vice-president for Quebec thanked Mr. Peachey for his talk.

Compliments were extended by Pierre Bournival, general secretary of the Corporation, to the E.I.C., for its co-operation with the provincial organization.

A buffet supper was served at the meeting, courtesy Codere Ltd., of Sherbrooke.

FREDERICTON

JOE WHITELEY, S.E.I.C., *Branch News Editor*

MUNICIPAL ENGINEERING, an outline of its applicability to the City of Fredericton was discussed by City engineer W. L. Barrett, of Fredericton at a branch meeting on February 13. Mr. Barrett explained the way in which the chain of command extends from the city council meetings to the city engineer's department and others. He went into the various responsibilities and duties of the department with respect to roads, streets, water and sewerage systems, public parks, sanitation, and associated works.

HAMILTON

J. R. CURRIE, M.E.I.C., *Branch News Editor*

A PLANT TOUR of the new Parkdale works of the Steel Company of Canada Limited was held by the Hamilton Branch on February 17, 1958. Approximately 70 engineers were welcomed by Parkdale works officials in the plant cafeteria. After refreshments were served a description of the basic planning and engineering aspects of the new mill was given by F. I. Morrissey, plant engineer.

Parkdale works is the newest and most modern of the four wire mills in Canada. The new annealing furnace installation is as large as any in North America. The nail mill division is the second largest nail mill in the country with an output of from 30,000 to 35,000 kegs per month. The plant is located at the eastern end of Hamilton harbour and is well serviced by ship, train, and truck. A description of the general operating features of the new mill was outlined by G. H. Layt, plant superintendent.

A tour of the plant including the electrical power distribution facilities and the boiler room followed. The mill buildings are dominated by the rod storage shed which at the present time also houses the patenting furnace. After this heat treating operation, wire coils are transferred to the pickle house to remove scale in preparation of the wire drawing operations.

The wire drawing machines are perhaps the core of the mill and are of the latest type, utilizing variable speed electric drives and tungsten carbide dies. The continuous galvanizing line occupies almost the entire east side of the new mill.

The feature of the nail mill was the manufacture of the spiral ardox nail, which is a development of the Steel Co. of Canada Ltd. Several large mills in the United States are now licensed to manufacture this special type of nail. Automation is the keynote in the production operations, with the number of actual production workers required at a very low figure.

Shown together during the Sixth Annual Slide Rule Soiree of the Calgary Branch, held at the Palliser Hotel, February 14, are l. to r.: Mrs. Smith, and W. A. Smith, branch counsellor, Mrs. Howard and A. W. Howard, Branch chairman.

MONCTON

V. C. BLACKETT, M.E.I.C., *Sec.-Treas.*

PROBLEMS OF OUTER SPACE were discussed in an address, by an outstanding scientist and astronomer, Father Burke-Gaffney, dean of the science faculty and professor of applied mathematics, Saint Mary's University, Halifax, N.S., at a joint dinner meeting of the Amherst and Moncton Branches, held at Moncton, on February 17. Sixty-five persons attended.

The speaker was introduced by G. E. Franklin, Moncton Branch chairman.

If satellites have issued in a new age, said Fr. Burke-Gaffney, it is a new age in transport. The new age is an age of Airless transport. In air transport, the aero engine is dependent on the air around it for the combustion of its fuel.

There are, already, two types of vehicles for airless transport,—the rocket and the satellite. The rocket differs from the jet aircraft in that it does not rely on the air around it for the combustion of its fuel, it carries its own oxygen with it, hence it can operate where there is no air. The satellite has no fuel. It has to be launched by a rocket,—thereafter it relys on its own inertial energy (due to the initial impulse given to it combined with the downward force of the attraction of the earth.)

The launching of the satellites was not begun to further the progress of transport, but as a project in pure science. Research satellites are an extension of the rocket research program.

Rocket research was organized during the International Geophysical Year in order to study the upper atmosphere, in particular the ionosphere. The chief centre of rocket research in North America is in Churchill, Man. Preliminary results from rocket research indicate that, after great activity on the sun, the lower layer of our ionosphere sometimes falls as low as 34 miles, that northern

lights and southern lights occur simultaneously, that the density of the atmosphere at a height of 140 miles is greater than was anticipated, and that the extent of our atmosphere (considered as particles which rotate in unison with the earth) is greater than we thought.

Incidentally, practical results may result from the findings of pure science. Our new knowledge of the ionosphere, may lead to long range radar, long range TV, long range weather forecasts. A knowledge of the properties of the upper atmosphere is essential if we are to design space-ships to pass through it.

Missiles and research rockets are very different projects. It is sufficient for the research rocket, or satellite-launching satellite to reach a certain height. A missile must be able to re-enter the earth's atmosphere without melting from the heat due to friction with atoms or molecules. The United States Army seemed to have solved the problem of re-entry for their missiles. It is only a question of adaption to solve it for satellites. For missiles there is the added problem of guidance. A rocket with liquid fuel is not easily guided, and solid fuels are not as efficient as liquid fuels. For the present, liquid fuels are being used for the first stage, and solid fuels for the later stages.

Failures in rocket launchings are inevitable, as they cannot be tested but by trial and error. The Germans had failures in their first V-2 launchings. The Russians probably did not proceed to success without preliminary failures. The first Vanguard failure was due to plumbing rather than science. The second, to one of the hazards of ergonomics (the human factor). The U. S. Army success, and the nature of its satellite, suggest that it was the Russian Army also, which was responsible for the sputniks.

Most anxious to get to the moon are astronomers desirous of being able to photograph sun, planets and stars without the interference of an atmosphere.

Fr. Burke-Gaffney was very critical of those who advocate a super-scientific educational program. Illustrating his point by referring to German technical supremacy at the opening of the Second World War, he stated that in any country a thorough general educational system could always cope with aggression on the part of a technically advanced society.

A lengthy question and answer period followed the address.

The thanks of the gathering was extended Fr. Burke-Gaffney by J. W. Wilson, chairman of the Amherst Branch.

NEWFOUNDLAND

R. P. HUNT, JR.E.I.C.,
Branch News Editor

NEWSPRINT MARKET CONDITIONS AND the operations of Bowater's Newfoundland were outlined by mill manager, George Hobbs of Bowater's paper mill, Corner Brook, Nfld., at a February 10 meeting. Members of the Association of Professional Engineers were invited to hear the talk. Mr. Hobbs gave a general outline of the production of paper at Bowater's mill, Corner Brook, from the woods operations through various precesses to the shipping of paper. Causes of the present conditions in the newsprint market, which have caused Bowater's to reduce their labour force was also discussed.

Bowater's operations in various parts of the world were illustrated by means of a short film.

After a lively question and answer period a vote of thanks was extended by Roy Myers.

Dinner meetings are a new enterprise for the Newfoundland Br. this year. Previously only annual meetings took this form. The large turnout of members at the dinner meetings this year indicated the popularity of this form of meeting.

Annual Meeting
1958

Quebec, Chateau Frontenac
May 21, 22, 23

NIAGARA PENINSULA

B. H. CHICK, JR.E.I.C.,
Branch News Editor

ROCKETS AND ALLIED FEATURES were the subject of a talk delivered at a meeting on January 30, 1958, to the Niagara Peninsula Branch of the Institute and the Niagara Group of Professional Engineers, who had been invited to attend. D. A. Bornum introduced guest speaker W. H. Smith, manager of the rocket division of the Bell Aircraft Corporation, Buffalo, N.Y., who discussed the development, operation and fuels used for various types of rockets. Mr. Smith also discussed some of the work being done at the Bell Aircraft Corporation. A film showing the testing of an experimental aircraft was also presented. A question and answer period followed.

SASKATOON

ROGER B. DUPUIS, M.E.I.C.,
Branch News Editor

THE DOUGLAS FIR PLYWOOD, its properties and uses was discussed before the Saskatoon Branch at a meeting held March 5, by A. W. Weston, Vancouver, and R. L. Robinson, Winnipeg, both members of the Plywood Manufacturer's Association of B.C.

The talk, which revealed interesting possibilities for the use of plywood in the structural field, offered instruction on the processes in manufacture of plywoods and the properties of the finished product. Another part of the discussion

● BRANCH NEWS

involved the uses of the product in fabrication of load supporting members.

Election of Officers

Elected for the 1958-59 term of offices were: chairman, J. B. Mantle; program committee, R. C. Strayer, chairman, P. Riemer, F. Catteral, N. E. Greenway, N. Peters; secretary-treasurer, R. E. Ludwig; publicity, R. B. Dupuis.

SAULT STE. MARIE

B. L. WIMPERIS, JR.E.I.C., *Sec.-Treas.*

THE REGULAR MONTHLY MEETING was held on February 14, 1958, and drew an attendance of twenty-eight members and guests.

After the business of the meeting, R. H. Tooley, Branch chairman introduced J. N. McLaren, Eastern field secretary, who addressed the group in order that members might be more familiar with the general aims involved in the work of the field secretary.

The Wellington Street underpass, Sault Ste. Marie, was the subject of a talk given by J. MacKenzie, City engineer of that locality. With traffic on the increase, he pointed out, the Western part of Sault Ste. Marie and outlying districts are accessible by only one major artery. To further complicate this matter the street is blocked off for considerable periods by switching from an adjacent railroad yard. A former road through a major steel plant has also been removed due to expansion of the plant, cutting off the area to a greater extent.

As a result an almost impossible traffic situation has resulted. The problem has been known for several years but little action has been taken until recently. This is mainly due to the fact that a breakdown for financing the project, between the railroad, the City and the department of highways, could not be decided.

Due to local interest in the underpass and publicity accorded it over the past few years Mr. MacKenzie's talk on financing and engineering details for the project, proved very interesting.

SUDBURY

M. D. HEAD, M.E.I.C., *Publicity*

THIRTY MEMBERS and guests attended a dinner meeting at the Granite Club on February 13.

J. F. McCallum introduced his colleague, D. W. Gray, assistant woods manager and logging engineer of the K.V.P. Company, Espanola, who delivered a very interesting talk on the company's woods operations. Mr. Gray described, in some detail, the extent of the company's "limits", or "concession", which covers more than five thousand square miles, and includes the watersheds of the Spanish and Vermilion rivers, and an adjacent area north of the height of land draining into Hudson's Bay. The company is cutting approximately 130,000 cords annually, and purchases a further 85,000 cords, including chips and sawmill waste. Jackpine forms the bulk of the pulpwood crop, but substantial amounts of spruce and poplar are also harvested. Mr. Gray stressed the fact that the forests are not a wasting asset. He summarised the company's policy as "The growing and harvesting at economical cost of the preatest amount of wood fibre per year, in perpetuity". The annual wood cut is actually considerably less than the annual growth and is spread over the whole of the presently accessible area.

In recent years, mechanisation of logging methods and improvement of handling and transportation facilities have greatly increased productivity. The bulk of the labour force can be fully employed from about May 1st to the following March, whereas at one time the season extended only from September to March. The once typical output of one cord per man day has been increased by more than one hundred and fifty percent. Further mechanical improvements currently being developed include facilities for handling full tree lengths without cutting, and integrated slashers and debarkers on the site.

After showing a number of slides, Mr. Gray faced an extended question period which demonstrated the meeting's keen interest in forest engineering.

Students' Night at the University of Toronto was reported in the March Journal. Here, a few of the student participants wait for turn at the quiz prize money.

TORONTO

GORDON F. R. NORTON, JR.E.I.C.,
Branch News Editor

FROM ICARUS TO EARTH SATELLITES was the subject of a paper delivered by Professor B. Etkin, professor of aeronautical engineering and research associate of the Institute of Aerophysics, University of Toronto, at a meeting on March 1, 1958.

The lecture covered the scientific story of flight, beginning with the first visions of human flight, and tracing the application of scientific discoveries to the solution of the problems of flight. It covered the work of the early experiments, carried out before the time of the Wright brothers, and the subsequent

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developments up to the time of supersonic flight. Jet propulsion, the sound barrier, and supersonic flight were touched upon, as well as problems confronted at the present time in relation to the heat barrier in flight at extreme altitudes and speeds. Professor Etkin concluded his talk with a discussion of earth satellites and astronautics,

The occasion was a joint meeting with the Royal Canadian Institute, at which Gordon G. Cosens, meeting chairman and president of the R.C.I., introduced Dr. Etkin.

R. N. Self, chairman of the Toronto Branch extended a vote of thanks to Dr. Etkin for his talk. Later the E.I.C. members were guests of the R.C.I. in the mechanical building.

VANCOUVER

J. J. KALLER, M.E.I.C., *Publicity*

PRESIDENT C. M. ANSON arrived in Vancouver for a two-day visit to the Vancouver Branch on February 9. He was accompanied by Dr. L. A. Wright, general secretary of the Institute.

After a brief tour of points of interest around the city, the Branch executive entertained Mr. Anson at a cocktail party at the home of Commodore A. C. M. Davy.

Following the tradition that each president visits the University of British Columbia engineering department, Mr. Anson addressed the engineering student body.

Following the tradition of each president visiting the University of British Columbia engineering department, Mr. Anson addressed the engineering students.

The Cambie Memorial

Old and young alike paid tribute to the man responsible for the planning of the entire course of the Canadian Pacific Railway through British Columbia, as the President on February 10, unveiled a plaque in honour of Henry J. Cambie, explorer, surveyor and engineer. The Cambie Street station, one of the main thoroughfares of the city, and previously named for the great man, was scene of the ceremony.

Unveiling the plaque, President Anson said, "Future generations of Canadians shall never forget the magnificent contributions of a great engineer and outstanding Canadian." The plaque was accepted on behalf of the C.P.R. by W. G. Dyer of Winnipeg, regional C.P.R. engineer.

The late Mr. Cambie was identified with the Toronto and Guelph Railway; conducted surveys for the Intercolonial Railway in Quebec, Nova Scotia and New Brunswick from 1865 to 1866, and supervised construction of the Windsor and Annapolis Railway in Nova Scotia in 1868.

A son and two daughters of the honoured man were present for the unveiling.

Professional Development Course—1958

The professional development course has again proved to be a great success. Prominent business men, outstanding in their respective fields of activity generously offered time in order to assist in broadening the knowledge of the participants of the course in the field of economics related to primary industries of British Columbia. The course was arranged for the Vancouver Branch under the able direction of Cliff H. White, chairman of the committee for professional development and Dr. A. D. Scott, of the department of economics of the University of British Columbia. The idea of economic appraisal of the natural resources of British Columbia has proven its value by the fact that enrollment for the course included men from professions other than engineering.

U.B.C. Student Section

BLAKE TWEDDLE, S.E.I.C.,
Student Representative

THE 1958 STUDENTS' NIGHT held February 4, 1958, in the lounge at Brock Hall, U.B.C., featured three student speakers selected by the members of the Student Branch "Toastmasters' Club". The students were the guests of the downtown members. Approximately one hundred members and students attended. After dinner Professor Heslop turned the meet-

ing over to student chairman Ship Saimoto who outlined student activities to date. Mr. Saimoto introduced John Duerksen, student vice-chairman, and chairman of the Toastmaster's club who introduced the speakers. First speaker to take the stand was Gero von Dehn whose subject was satellites. Construction, methods of launching, tracking and recovering satellites was discussed. Phil Hahn, second speaker, dealt with "The History of Aluminum" and supplemented his talk by remarking on his experience while an employee with the Aluminum Company of Canada Limited at Kitimat, B.C. Stan Toole, winding up the talks, gave a description of the Avro Arrow.

Named in order of merit as speakers, judges awarded first place to Stan Toole; second and third to Gero von Dehn and Phil Hahn.

President's Visit

President Anson, accompanied by Dr. L. A. Wright, general secretary of the Institute visited the University on February 10. Addressing engineering students Mr. Anson spoke of the part the Institute may play in an engineer's career.

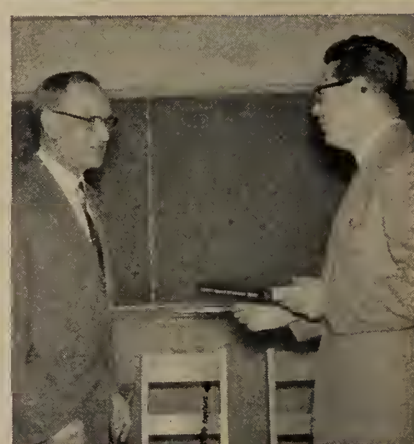
Dr. Wright outlined the services provided by the E.I.C.

Mr. Anson presented the E.I.C. prize to Keith Minielly in recognition of his outstanding contributions to student activities and also for his outstanding scholastic record.

A copy of "Daylight Through the Mountain" was presented to Murray Roblin on behalf of the E.I.C. and Engineering Undergraduate Society by the president. The book will be placed in the library of the engineering building.

The meeting was followed by luncheon at the faculty club, attended by the executive of the student branch and the E.U.S., Dean Gunning, Professor Heslop, Professor de Jong, Professor Richmond, Mr. Anson and Dr. Wright.

Featured at Students' Night at U.B.C., held February 4, 1958, were talks by three student speakers. In top photo with student executive are, l. to r.: Gero von Dehn, Ship Saimoto, student chairman, Phil Hahn, Stan Toole, and John Duerkson, student vice-president and chairman of the Toastmasters' Club. Below, Mr. Anson presents the E.I.C. prize to Keith Minielly, and a copy of "Daylight Through the Mountain," to Murray Roblin on behalf of the E.I.C. and the Engineering Undergraduate Society.



News of Other Societies

Canada-U.S. Chemical Engineering Conference

The Canadian-U.S. Chemical Engineering Conference, sponsored jointly by the American Institute of Chemical Engineers and the Chemical Institute of Canada, Chemical Engineering Division, is expected to be one of the outstanding conventions in North America this year.

The conference will be at the Mount Royal Hotel, Montreal, April 20-23, 1958. The conference secretary is F. K. Rogers, Shawinigan Chemicals Limited, Montreal.

There will be seven European participants in a review of the chemical industry on that continent. They are Dr. Paul Ferraro, Belgium; Dr. R. Holroyd, London; J. J. Desportes, Paris; Dr. Karl Winnacker, Frankfurt, West Germany; Prof. Giulio Natta, Milan, Italy; and two members of the Soviet Academy of Sciences, Moscow.

Scheduled for Sunday, April 20, is a symposium on "Chemical Engineering Education in the U.S. and Canada". Three Canadian and three American university representatives will discuss the subject.

Three technical sessions on April 21 are to be chaired by Dr. H. H. Lank, of DuPont of Canada (1956) Ltd., Montreal, Dr. R. S. Jane, of Shawinigan Chemicals Ltd., Montreal and Dr. J. H. Shipley, chairman of the C.I.C. Montreal section. They will consist of the discussions of "The Chemical Industry in Europe Today" presented by the European speakers mentioned above.

A technical session on "Statistics in Chemical Engineering", April 21, will have speakers representing the U.S. chemical industry and one from Princeton University. Also on April 21, there will be a symposium on "Chemical Engineering Problems in Heavy Water Reactors" with chairman and speakers drawn from the Canadian and American specialists in nuclear reactor research and design. "Chemical Engineering in Mineral Processing", and "High Temperature Materials for Jets and Rockets" are the topics of technical sessions on April 22, with the Canadian and American industries represented. There will be two sessions on "Fluid Mechanics" on April 22, with speakers representing nine universities.

A panel discussion on "Relationships between Investors and Chemical Industry Management" is on the program of April 22; "Noise in the Chemical Industry" will be treated in a symposium. There are Canadian and Americans participating in both sessions.

The sessions of April 23 start with a symposium on "Future Sources of Energy" with five speakers and, simultaneously, a symposium on "Chemical Engineering in the Pulp and Paper Industry". There will be two sessions the same day for General Technical Papers in which a variety of important papers will be presented.

"Modern Engineering Construction Techniques" will be discussed in a symposium by four American speakers; and "Career Opportunities in Chemical Engineering" in Canada and in the United States will be discussed in a afternoon session.

In addition, the program includes a number of plant visits, luncheons with well known speakers, and a French Canadian "Habitant" dinner and square dance.

Canadian Institute of Timber Construction Convention

The fifth annual convention of the Canadian Institute of Timber Construction was held in Ottawa, February 24-28. Participating in a one-day session known as "open day" were architects, engineers, and government officials in a program designed to review advances made by the wood products industry.

Many active committees reported progress. The design manual committee reported that the C.I.T.C. design manual will in 1958 appear for the first time in one volume.

The standards committee finalized work on the qualification code being established to ensure uniformly high standards of quality in wood products plants.

The service records committee reported progress in the collection of service records of pressure-treated timber construction jobs across Canada.

Members of C.I.T.C. and industry staff members have been active in the development of C.S.A. standards. New specifications on engineering design in timber are approaching completion.

Incoming president D. E. Ness, president of timber structures division of Foldaway Furniture Ltd., Peterborough, Ont., pointed out that during the previous year, work calculated to create an entirely new basis for engineered timber construction had been completed and would appear in printed form in 1958.

Luncheon speaker on "open day" was Professor Carson F. Morrison, head of the department of civil engineering, University of Toronto. In a statistical breakdown of the type of work being conducted by engineers, Professor Morrison remarked that only 15 per cent of Canada's engineers were actively engaged in research.

A highlight of the convention was an outstanding group of exhibits from many countries which told the story of the industry.

Chemical Institute Appointment

T. H. Glynn Michael was recently appointed general manager and secretary of The Chemical Institute of Canada. Mr. Michael was formerly director of research, Howards & Sons (Canada) Limited, Cornwall, Ont.

As general manager, Mr. Michael will serve as executive officer of the Institute, under the direction of the board of directors. He will be responsible for the administration of the numerous services provided by the head office of the Institute in Ottawa. Mr. Michael will also serve as managing editor of the C.I.C. publications *Chemistry in Canada* and *The Journal of Chemical Engineering.*

Calendar

F.I.S.I.T.A. Congress at Paris

The Federation Internationale des Societes d'Ingenieurs et Techniciens de l'Automobile will hold its Seventh International Technical Congress from May 19 to 28. The event will include visits to principal factories of the French automobile industry.

About twenty technical papers prepared by eminent writers on subjects of their choice will be presented and discussed. These will represent a most valuable contribution on the part of the eight European societies belonging to the Federation. Also, in granting their co-operation, several world famous lecturers will render the 7th F.I.S.I.T.A. Congress all the more successful. Member societies affiliated with F.I.S.I.T.A. will be represented at the congress from Germany, Great Britain, Austria, Belgium, Spain, France, Italy, Poland, and Switzerland.

For information on the congress and registration forms write: the Secretariat General, F.I.S.I.T.A., 5, Avenue de Friedland, Paris 8.

Fifth World Petroleum Congress, Inc.

The first international oil congress ever to be held in the United States, will open on May 31, 1959. The event is expected to attract some five thousand scientists and technologists from more than thirty-five countries. The congress is being widely supported by the petroleum industry in the United States.

Chairman of the national committee for Canada is C. E. Carson, 111 St. Clair Avenue West, Toronto.

Mechanical Handling Exhibition

The Mechanical Handling Exhibition, first organized in 1948 to impress upon the world of production the importance of materials handling as a vital means of reducing manufacturing costs and increasing output, will be held in London, England, from 7-17 May, 1958. With upwards of half-a-million square feet of floor space, it will be the largest exhibition of its kind anywhere in the world. For the first time in its history, the 1958 exhibition will be international and will be open to leading manufacturers throughout the world.

For further information please contact: Derek Page, press officer, Associated Iliffe Press, Dorset House, Stamford Street, London S.E.1.

Operations Research Society of America

The thirteenth national and sixth annual meeting of the Operations Research Society of America will be held at Boston, Mass., on May 15, 16 at the Sheraton-Plaza Hotel.

Inquiries should be addressed to: Dr. Herbert P. Galliher, Operations Research Project, Room 6-218, Massachusetts Institute of Technology, Cambridge 39, Mass.

The American Society of Mechanical Engineers

The Society will sponsor or co-sponsor twenty-four major events dealing with numerous technical subjects at locations throughout the country during 1958. These meetings are open to interested persons, members or non-members. During May and June four meetings will take place. These are the Oil and Gas Power Conference and Exhibit at Philadelphia, May 11-15; the Materials Handling Conference, at Cleveland, June 9-12; participation in the 3rd U.S. Congress of Theoretical and Applied Mechanics, Providence, R.I., June 11-14; and a semi-annual meeting in Detroit, June 15-19.

The information was released from: L. S. Dennegar, director of public relations, The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, New York.

American Institute of Chemical Engineers

The American Institute of Chemical Engineers will celebrate its fiftieth anniversary with a Golden Jubilee Celebration from June 22-27 at its birthplace of Philadelphia. It will include an interesting technical program, summarizing the accomplishments of chemical engineering in all fields of unit operations and allied areas over the past half-century. Deficiencies in the present state of knowledge will be spotlighted and possible methods to close these gaps will be forecasted.

For further information write: Joseph I. Sacova, Socony Mobil Oil Company, Inc., Paulsboro, New Jersey.

Experimental Stress Analysis Meeting

The Society for Experimental Stress Analysis 1958 Spring Meeting will be held on May 14, 15, and 16, 1958, at the Hotel Manger, Cleveland, Ohio. Further information regarding this event may be obtained by writing: Dr. W. M. Murray, secretary-treasurer, Society for Experimental Stress Analysis, P.O. Box 168, Cambridge 39, Mass.

American Society of Tool Engineers

The American Society of Tool Engineers will hold its 26th Annual Convention and Tool Show in the Philadelphia Convention Center, May 1 to 8. Nearly 500 exhibitors will participate in the show which has as its theme "Tooling on Competition".

For further information contact: Richard Gebers, public relations manager, American Society of Tool Engineers, 10700 Puritan Avenue, Detroit 38, Mich.

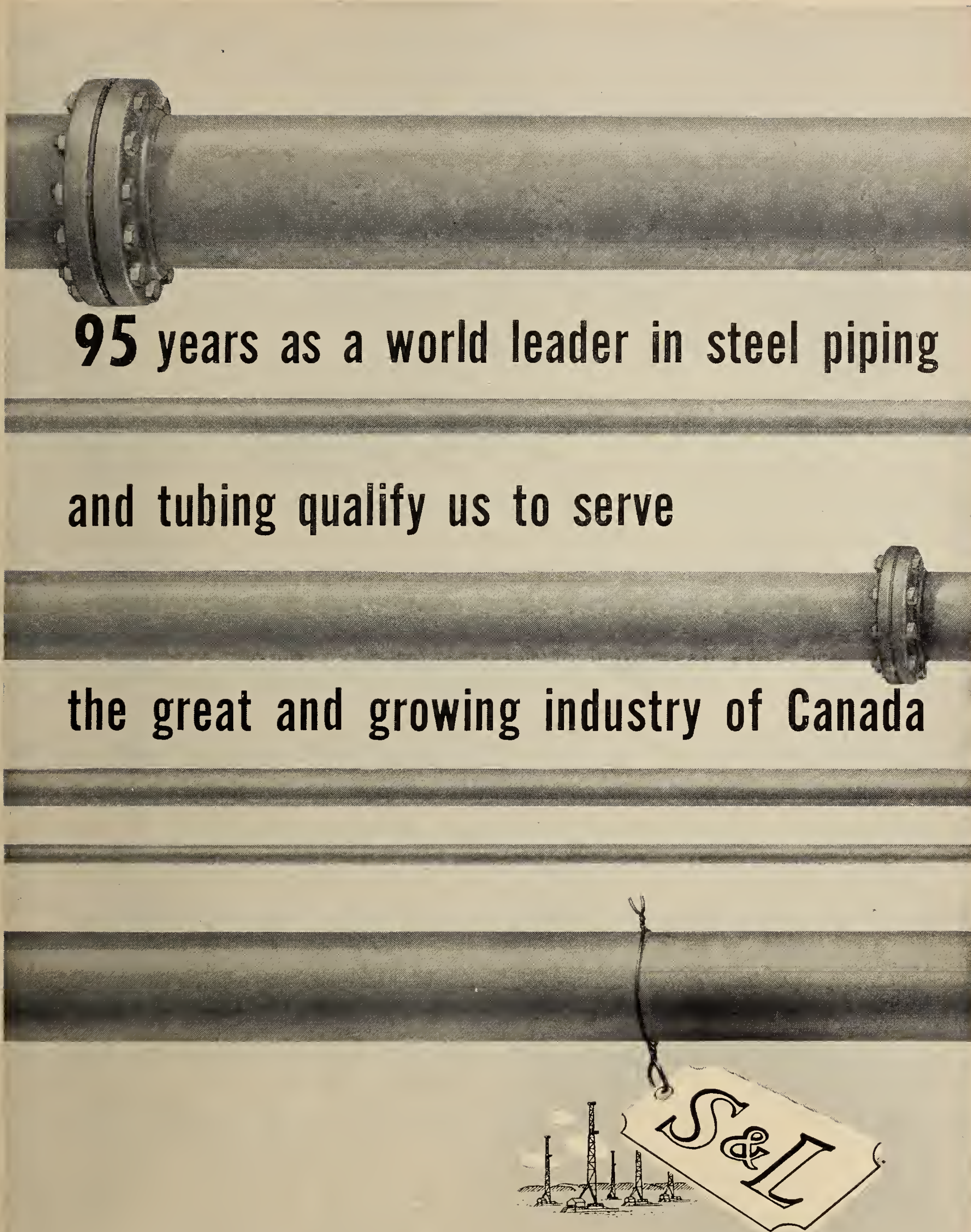
Cost Reduction Conference

Sponsoring the Cost Reduction Conference is the Illinois Institute of Technology, Chicago, Illinois, at a meeting to be held May 8 and 9, 1958, in the Metallurgical and Chemical Engineering Building, at 10 W. 33rd Street.

Inquiries concerning the conference should be made to LeRoy A. Wickstrom, Illinois Institute of Technology, Chicago 16, Ill.

French Public Works Congress

The International Exhibition of Public Works and Building Equipment will be held near Paris from May 14-24, 1958. Theme of the congress will be adaptation of equipment plants to present day technique. For information write: Syndicat M.T.P.S., 10, Ave. Hoche, Paris VIIIe.


95 years as a world leader in steel piping
and tubing qualify us to serve
the great and growing industry of Canada
S&L

LIBRARY NOTES

ADDITIONS TO THE INSTITUTE LIBRARY • REVIEWS • BOOK NOTES • STANDARDS

BOOK NOTES

Prepared by the Library, The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

*ADVANCED DYNAMICS

Covers the dynamics of beams, rectilinear motion, angular motion, plane motion, and motion in three dimensions. Concepts used include D'Alembert's principle, Lagrange's equation of motion, the free-body diagram, and the ellipsoid of inertia. Numerous problems are worked out in detail to illustrate the application of principles and methods, and where possible alternate methods of solution are presented. (J. E. Younger. New York, Ronald Press, 1958. 265p., $8.50.)

*ANALYSIS OF MULTISTORY FRAMES

Translated from the fifth German edition by C. J. Hyman, this text emphasizes frames with linearly displaceable joints. An iteration procedure is used that consists of a repetition of the same operation, thereby reducing the probability of a computational error. Aspects discussed include analysis of structures with nontranslatory joints, story frames with joints movable horizontally, separate verification of end movements, influence lines, and structures with bars of variable cross section. (Gaspar Kani. London, Crosby Lockwood, 1957. 113pp., £2.)

*AUTOMATION AND MANAGEMENT

Three major aspects of automation are studied extensively in this report. The first section provides a background on the nature of production line mechanization and the growth of automacity in manufacturing, while the second describes the automation programs of thirteen plants with respect to conception, design procurement, installation, and debugging experiences. The final section discusses the impact of automation on maintenance, the skill requirements of the work force, and management. (J. R. Bright. Boston, Harvard Business School, 1958. 270p., $10.00).

*BASIC ELECTRICAL ENGINEERING

Both alternating and direct current circuits are presented. Basic network considerations are developed and a treatment of node-voltage and mesh-current methods is given. The material on magnetism and magnetic circuits includes the concepts of domain theory, and a final chapter explains the theory and operation of modern electrical instruments and meters. The rationalized MKS system of units is used. (R. H. Nau. New York, Ronald, 1958. 437p., $7.00.)

*LE CALCUL DES TUYAUTERIES A HAUTE TEMPERATURE

The growing use of extensive piping systems in increasing complexity and under conditions of high pressures and temperatures necessitates design methods to establish the most economic lengths and pipe thicknesses for various installations. This work provides first a theoretical treatment of the problem, and following this a section on practical application. Arranged for solution by an electronic computer, the book gives symbolic representations for 40 different combinations of joints, anchorages, and constraints, and one fully worked out design problem. (A. Gage. Paris, Dunod, 1957. 166p., 2,900 fr.)

*DICTIONAIRE FRANCAIS-ANGLAIS DES TERMES RELATIFS A L'ELECTROTECHNIQUE, L'ELECTRONIQUE, ET AUX APPLICATIONS CONNEXES

This new compilation covers all aspects of electrical engineering with particular attention to both theoretical and practical electronics: radio, television, radar, hyperfrequencies (microwave region), photoelectricity, etc. Many words and terms are included from related fields, such as acoustics, optics, plastic materials, machinery, and nuclear physics. The English terms conform to the recommendations of the American Standards Association and the British Standards Institution. (H. Piraux. Paris, Editions Eyrolles, 1956. 168p., 960 fr.)

*DIRECTORY OF GEOLOGICAL MATERIAL IN NORTH AMERICA, 2ND ED.

Although primarily of interest to the petroleum geologist the information contained is broad enough to be of value to other geologists as well. It is divided into two parts, a general section listing sources in the U.S., Canada, Mexico and the West Indies, and a local section indicating sources restricted to states and provinces. Sources for a variety of information are given such as for maps, air photographs, guide books, drillers and electric logs, scouting and drilling information, well cuttings, well elevations, publications, etc. (J. V. Howell and A. I. Levorsen. Washington, American Geological Institute, 1957. 208p., $3.00.)

*ENGINEERED WORK MEASUREMENT

A unified text that encompasses the essential principles, data, and techniques of methods-time measurement, modern time and motion study, and related applications engineering data with a view to developing labor standards and better manufacturing methods. The major portion of the book is devoted to the fundamentals of methods-time measurement. Terms are defined and illustrated, and special mathematics, standards, applications, and the development of training courses are covered in detail. (D. W. Karger and F. H. Bayha. New York, Industrial Press, 1957. 635p., $12.00.)

THE ENGINEERING INSTITUTE LIBRARY

The publications mentioned in these Notes are now available in the Library. Members of the Institute may borrow books, periodicals, pamphlets, etc. from the Library. The loan period is two weeks, excluding time in transit, and two items may be borrowed at one time. Library hours are: Monday to Friday: 9 a.m. — 5 p.m.; Saturday, 9 a.m. — 12 noon.

Because of a recent change in policy, publications (except periodicals published by other engineering societies) may no longer be purchased through the Library. If members have difficulty obtaining material locally, it is suggested they write to the Library, and the enquiry will be forwarded to an appropriate bookseller. For further information write to the Librarian.

● LIBRARY NOTES

*HIGHWAY RESEARCH BOARD PROCEEDINGS, 36TH ANNUAL MEETING

A collection of papers, presented at the 1957 meeting, covering virtually every phase of research activities in the field of highway administration and technology. The contents are grouped as follows: economics, finance and administration, including cost studies made in several geographic areas; design, with particular reference to airport pavement; materials and construction; maintenance; traffic and operations, including an extended study of the California Freeway capacity, and soils. (Washington, U.S. National Research Council, 1957. 834p.)

*HISTORY OF HYDRAULICS

The authors have chosen as their historical theme the formulation of the underlying principles of fluid motion. Considerable attention is given to the men who bore the brunt of the development and to their related interests and accomplishments. In general the subject of hydraulics is not treated as an isolated phenomenon but is placed within its proper historical perspective beginning with antiquity and progressing to the twentieth century. (Hunter Rouse and Simon Ince. Iowa City, Iowa Institute of Hydraulic Research, 1957. 269p., $5.00.)

*KEMPE'S ENGINEER'S YEARBOOK

A new edition of a handbook covering virtually all fields of engineering. Although all sections have been rewritten to some extent, the following areas have been extensively revised: welding and cutting; water engineering; corrosion and protective coatings; blasting processes and new abrasive material; aerodynamics and aircraft propulsion; electronic engineering; atomic power; heating; ventilating, and air conditioning. (London, Morgan, 1958. 2 vols., 82/6.)

*MANUFACTURING MANAGEMENT, REV. ED.

In the revised edition of this comprehensive test increased emphasis has been placed on capital expenditures, cost control, operations research, and linear programming. Also included is a realistic appraisal of the advantages and disadvantages of computers. Case studies have been incorporated into the text rather than at the end of the book as in the previous edition. (F. G. Moore. Homewood, Ill., Irwin, 1958. 843p., $8.35.)

*MECHANICAL ENGINEERING LABORATORY PRACTICE

This textbook covering the general field of mechanical engineering is divided into three parts. Part 1, principles of mechanical engineering, deals with laboratory philosophy, techniques of laboratory procedure and the writing of the engineering report. Part 2 is devoted to the discussion of laboratory instruments while part 3 includes laboratory exercises. The appendix contains useful tables giving conversion factors, properties of common substances, properties of steam, etc. (E. E. Ambrosius and R. D. Fellows. New York, Ronald, 1957. 539p., $7.00.)

*MOTION AND TIME STUDY, 4TH ED.

In addition to the basic material contained in previous editions of this work five new chapters have been added dealing with motion study, mechanization, and automation; mechanized time study and electronic data processing; systems of motion-time data; work sampling; evaluating and controlling factors other than labor. New material is included on developments in the industrial use of pulse rate as an index of physical activity, and all known systems of motion data are outlined and described. (R. M. Barnes. New York, Wiley, 1958. 665p., $9.25.)

*PAPERS ON SOILS

Papers dealing with testing and research projects on soils. Topics investigated include: soil explorations for site selection and engineering design; theory of soil resistance; evaluating friction and cohesion of soils; microseismics; vibration techniques used in soil compaction; field tests of piles in sand; properties of soil cement mixtures. (Philadelphia, A.S.T.-M., 1957. 178p., $4.50. s.t.p. 206.)

*QUEUES, INVENTORIES AND MAINTENANCE

The first of three projected volumes, this volume is an introductory monograph to the subject of queuing problems and discusses the effect of change of arrival and service distributions on queuing results. Queuing problems are dealt with from the standpoint of the Kolmogorov equations relating the probabilities, and specific applications such as those relating to repair and maintenance of machinery are analyzed and

solved. The book is No. 1 in the series.

• LIBRARY NOTES

Operations Research Society of America, Publications in Operations Research. (P. M. Morse. New York, Wiley, 1958. 202p., $6.50.)

*SYMPOSIUM ON THERMAL CONDUCTIVITY MEASUREMENTS AND APPLICATIONS OF THERMAL INSULATIONS

Six papers dealing with the development of specifications and methods of test for thermal insulating materials. Aspects included are analyses and experimental procedures by which criteria may be developed, improvements and modifications of the apparatus within the scope of the test method, the effect of moisture on thermal insulation, and the use of thermal insulation for underground piping. (Philadelphia, A.S.T.M., 1957. 86p., $2.75. s.t.p. 217.)

*SYMPOSIUM ON VANE SHEAR TESTING OF SOILS

Papers dealing with a comparatively recent development in the testing of soils. An introductory paper on the apparatus and method of vane shear testing is followed by three specific applications: deep vane tests in the Gulf of Mexico; a vane in-place soil shear measuring device developed and applied in Oregon; the use of a field vane apparatus in sensitive clay. (Philadelphia, A.S.T.M. 70p., $2.50. s.t.p. 193.)

*TECHNIQUES OF MAGNETIC RECORDING

After an historical introduction to the development of magnetic recording, information is provided on technical aspects such as recording media, drive mechanisms, erasing, recording procedures, and spurious printing. Considerable attention is given to the techniques employed in its use, particularly in relation to radio, motion-picture and television, medicine, and education. (J. Tail. Toronto, Brett-Macmillan, 1958. 472p., $7.95.)

*THERMODYNAMICS OF HEAT POWER

Although descriptive material has been included, major emphasis is on the development and application of theory, particularly as applied to steady flow systems. Topics included are ideal gases; compressors; turbines; internal combustion engines; liquids and vapours; heat exchangers; nozzles and fluid flow; reciprocating steam engines; mixtures; fuels and combustion; pumps and fans. The book is a revised edition of the author's "Theory and Practice of Heat Engines". (V. M. Faires. Toronto, Brett-Macmillan, 1958. 432p., $8.00.)

*TRAITE DE MECANIQUE DES SOLS

A comprehensive treatment of soil mechanics, beginning with a general section on the physical properties of soils, especially permeability. The second section deals with specific mechanical properties of soils: stresses and deformations; settlement; vibration phenomena; equilibrium; and shearing action in both cohesive and cohesionless soils. The third section covers engineering applications: methods for improving soil properties; pressures on retaining walls; pressure distribution under foundations and bearing capacities; and special topics such as piling, tunnels, roadway loading, and earth slopes. (A. Caquot and J. Kerisel. Paris, Gauthier-Villars, 1956. 558p., $11.15.)

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Aeronautical Engineering

Dual-operation powerplants for vertical take-off transport aircraft; a preliminary analysis of several gas-turbine cycles, by E. P. Cockshutt. Ottawa, National Aeronautical Establishment, 1957. (Laboratory report LR-201)

VTOL transport aircraft; a brief discussion of Canadian requirements and project study results for tilting-wing configurations with two propellers and four propellers, by P. J. Pocock and A. J. Bowker. Ottawa, National Aeronautical Establishment, 1957. (Laboratory report LR-204).

Business Forecasting

The business forecast for 1958. Prudential Insurance Company of America.

Canadian economic forecast for 1958. Prudential Insurance Company of America, Canadian Head Office.

Concrete

Loss in prestress of post-tensioned members due to creep and shrinkage of concrete. S. Ban and others. (Technical reports of the Engineering Research Institute, Kyoto University. v. 7, n. 5, Report no. 39)

Safe loads and properties for square tied columns to CP. 114 (1957) part one, by A. d'O. Smith. Richmond, Surrey, 1957.

Electrical Engineering

The attenuation characteristics of the coaxial laminated cable, by S. Hayashi and K. U-O. (Technical reports of the Engineering Research Institute Kyoto University, v. 7, no. 6, report no. 40)

Co-operative electrical research, being the journal of the British Electrical & Allied Industries Research Assn. No. 4, Jan. 1958.

Electrical Research Association; technical reports: C/T116—The testing of wind-driven generators operating in parallel with a network, by D. E. Villers. D/T102—Synthetic resin cements for glass-to-metal seals for use in flameproof enclosures, by H. F. Church. G/T306—The variables that arise in contactor testing, by H. W. Baxter and Z. Cetnarowicz. G/XT160—A simple and inexpensive emission regulator for ionization gauges, by M. P. Reece. L/T341—Reverse driving of short arcs, by A. E. Robson. N/T74—Some magnetic properties of dilute anisotropic ferromagnetic alloys, by W. Sucksmith.

Rules governing the short-circuit testing of air-blast circuit-breakers for alternating current systems. (Assoc. of Short-Circuit Testing Authorities.)

Engineering Education

The case for increasing student aid. Toronto, Industrial Foundation on Education, 1958.

Industrial Management

16 questions about the selection and training of managers, by L. Urwick. Lond., 1958.

Techniques and procedures in labor arbitration: selected references. Industrial Relations Section, Princeton University, No. 79, Jan. 1958.

Metals and Alloys

Nickel in ancient bronzes, by C. F. Cheng and C. M. Schwitter. (reprint from American Journal of Archaeology, v. 61, n. 4, Oct. 1957.)

Quick determination of creep limit, by T. Nishihara and others. (Technical reports of the Engineering Research Institute, Kyoto University, v. 7, n. 4, Report no. 38)

Natural Gas

Facts about natural gas in Alberta. Calgary, Canadian Western Natural Gas Co. Ltd., 1957.

STANDARDS RECEIVED

ASTM standards. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

ASTM standards on petroleum products and lubricants.

ASTM standards on refractory materials, manual.

1957 supplement to book of ASTM standards including tentatives. Part 1, Ferrous metals; Part 2, Non-ferrous metals; Part 3, Cement, concrete, ceramics, thermal insulation. road materials, waterproofing, soils; Part 4, Paint, naval stores, wood, cellulose, wax polishes, sandwich and building construction, fire tests; Part 5, Fuels, petroleum, aromatic hydrocarbons, engine antifreezes; Part 6, Rubber, plastics, electrical insulation; Part 7, Textiles, soap water, paper adhesives, shipping containers.

Canadian Standards. Canadian Standards Association, 235 Montreal Rd., Ottawa 2, Ont.

CSA C22.1-1958: Canadian electrical code, part 1, essential requirements and minimum standards governing electrical installations for buildings, structures and premises.

CSA testing laboratories list of approved oil-burning equipment, 4th ed.

CORRECTION

In the February issue Specification W55.2-1957: Specification for resistance welding practice was incorrectly listed as an ASTM Standard.

It is, of course, issued by the Canadian Standards Association.

Our Advertisers

1918

Each issue of *The Engineering Journal* has been of value and interest to its readers because of the high quality of its technical content and the "news" it has contained.

The word "news" is intended to include the advertising pages. During forty years of continuous publication these pages have presented a concise and accurate description of the products and services required by engineers in the furtherance of their work.

When the *Journal* was founded in May 1918, World War I was in its final stages. During that war Canada started to emerge from the chrysalis stage in power development, manufacturing and general industrial expansion.

First Professional Periodical

Before the founding of *The Engineering Journal* there was no Canadian periodical directed primarily at our professional engineers. As a result they read foreign periodicals. The introduction of the Journal changed all this. At last, here was an all-Canadian publication designed, edited, and produced for, and by, Canadian engineers. Progressive organizations with goods and services to offer Canada's engineers were quick to realize the important market they could reach through *The Engineering Journal* and from number one of volume one each issue has carried informative advertising.

It is interesting to note that a number of the companies which advertised in the first volume are still represented on the advertising pages of the *Journal*. It is also encouraging to note that these firms, like the Institute, have shown steady progress and that their names, products, and services are now "household words" among Canada's engineers.

The advertisements in the first issues, as today, were accurate and concise in their messages and generous in their offers of service to the engineer in his work.

Varied Products

The products offered were varied and the advertising content of the first few issues can be used as a good indication of what, in 1918, the engineer required or bought.

The Pratt & Whitney Co. of Canada Limited offered small tools with emphasis on adjustable blade reamers.

Here is a description of some of the advertisements which appeared in the 1918 issues of the *Journal*. They represent a good cross-section of Canadian industry and what engineers required and bought forty years ago.

It is of interest to note that many of the firms represented in volume one are still regular *Journal* advertisers. These early technical advertisements, as today, constituted a rich source of valuable information for the buyer of engineering services and equipment.

The John Bertram & Sons Co. Ltd. complimented the Institute on the inception of the *Journal* which "increased Institute activities and broadened scope". The advertisement continued by reminding the readers that "for sixty years the Bertram organization has been supplying in Canada machine tools built for safety and service".

Canadian General Electric Co. Ltd. offered electric furnaces, arc welders, motors, generators, transformers, switchboards and "general supplies". The copy, in many ways, is a masterpiece of concise statement. For example: "Among the advantages of electric heat are greater thermal efficiency, since electricity is changed into heat without loss." The copy concludes with the statement "Any problem involving the use of power can be simplified by the application of electricity. The Canadian General Electric Company is well equipped to lend valuable assistance in working out such problems and is glad to cooperate with manufacturers, engineers and contractors in every possible way". Under the company name is a listing of thirteen C.G.E. offices, centred in what are, today, among the hubs of our industrial developments. Then, as now, the letters "C.G.E." stood for quality and service in electrical work — small wonder that through the years this organization has played a leading part in the progress of Canada.

A Long Connection

Dominion Bridge Company Limited featured a large coal handling conveyor in their first advertisements. Even as far back as May 1918 this fine Canadian Company had four principal "works" and seven sales offices. The range of products and services offered included "railway and highway bridges, buildings, turn-

. . . a 40-year-old partnership in progress

The first Jenkins Valves advertisement in The Engineering Journal appeared in October, 1918. During the intervening 40 years, the pages of the Journal have reflected the rapid expansion of Canada as one of the world's leading industrial nations. This industrial progress has been paralleled by the continued growth of Jenkins Bros. Limited and its service to increasing numbers of clients across Canada — many of whom are professional engineers.

ON THE OCCASION OF ITS 40TH "BIRTHDAY", we of Jenkins Bros. Limited salute The Engineering Journal for its major contribution to the engineering profession. Its pages have played a part in making the "Diamond" trade mark a familiar symbol of quality and efficiency in valves.

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
TRADE JENKINS MARK

Jenkins Bros

JENKINS BROS. LIMITED
Lachine, Montreal 32, Canada
Sales Offices:
Toronto, Winnipeg, Edmonton, Vancouver
Making valves is our business—our only business.

tables, electric and hand-power travelling cranes, coal and ore handling machinery; lift locks and hydraulic regulating gates; transmission poles, towers — forgings, gear cutting and general machine work."

The Canadian engineer knows and respects "Dominion Bridge" for its "know-how" and co-operative service. How many contacts between engineer-customers and this fine engineering organization have been brought about — and strengthened — by the advertising in *The Engineering Journal?* Evidently the Company has good reason to think that the answer is "plenty" because this publication heads the list of the technical periodicals in which "D.B." advertising is placed.

A British organization **Electro-Metals Limited** offered Electric Steel furnaces, and on the facing page of issue number one is the advertisement of another organization which is still using the *Journal* on a regular basis — **Neptune Meter Company** — Neptune sales and service have kept apace with the development of Canada. For example, the community in which the writer of this article resides was a village of under 1,000 people in 1918; in 1945 it was under 5,000 and today it is a "city" of over 15,000 and *every home* is equipped with a Neptune water meter. The city engineer and his consultants are members of the Institute. No doubt, the continuous advertising of this company in *The Engineering Journal* assisted them in their decision to recommend and buy "Neptune".

Unbroken Record

On the page facing the listing of editorial content **Canadian Ingersoll-Rand Company** greets the first issue of The Journal and congratulates the Institute on its expansion. The "ad" continues "Members! When you hear the name Canadian Ingersoll-Rand Company you *immediately* think of compressed air machinery — compressors, drill hoists, 'Little David' riveters, and grinders. Why? — because 'quality' has always been our watchword; you may be sure it always will be". Again, Canada-wide branches are listed, all in what are today, as then, strategic and logical distribution centres.

A special word must be written here about Canadian Ingersoll-Rand and *The Engineering Journal.* This all-Canadian Company has advertised in *every issue.* The early advertisements occupied the page facing "Contents", but ever since cover spaces have been sold "C.I.R." has been on the outside back cover. None will dispute the important part "Ingersoll-Rand" has played in providing equipment and employment for countless thousands of Canadians. The Company has grown, and is growing, with Canada. A few years ago the sales development manager of the Company said: "It has always been our policy to use the periodicals of professional associations as keystones in our advertising programs" — the *Journal* is proud of this long association and the confidence this advertiser has in its "effectiveness".

A Fine Letter

In the first issue The Canadian Fairbanks Morse Company Limited, then, as now, with headquarters on St. Antoine Street, Montreal, has a full page advertisement facing the "first page of editorial matter". The advertisement is in the form of the reproduction of a congratulatory letter which so concisely explains the function of the *Journal* that it is quoted below:

> "The Institute is to be congratulated upon the growth which has made the *Journal* possible and the actual development of the publication.
>
> The quality of the whole fabric of closely interwoven interests which it serves will be improved by the *Journal.* It is an organ needed by both the Dominion and the Institute. It will bind the branches together and facilitate the gain and interchange of professional knowledge.
>
> The development of Canada's vast material resources, from the conception to consumption—the production, transportation and marketing must be brought about by engineers in all fields. A medium which stimulates their work aids in the increase of Canadian production.
>
> As merchants of the tools for this material development we fully appreciate the importance to the *Journal's* mission and we wish it all success".

This firm, too, has grown with Canada and it is interesting to note that even forty years ago two factories (one in Toronto and one in Sherbrooke) and twelve branches, from Saint John, N.B. to Victoria, B.C. were in operation.

The **"Barrett" Company Limited,** with six branches, offered samples of "All made in Canada" building materials. The Company's range has expanded but the trade names shown in the advertisement are as well, or better, known today than they were forty years ago.

Oil and Power

Imperial Oil Limited ran its first advertisement in the December 1918 issue. The copy theme is most interesting because it is based on postwar activities. Emphasis is on road building and the advertisement states:

"Imperial Oil is ready to meet every call. Our facilities for production were never better. Our big, modern refinery at Montreal East, which we have recently enlarged, is engaged in refining all kinds of Imperial asphalts in huge quantities". Reference is made to "our own fleet of tankers".

Imperial Oil has grown with Canada. Always a progressive organization, we wonder if, even in their most elaborate plans for the future, they visualized what terrific expansion Canada would experience during the middle of this century and the important part Imperial would play in these developments.

The Shawinigan Water & Power Company—Quebec's "free enterprise" power developing and distributing organization — commenced its long association with the *Journal* in the October 1918 issue. The advertisement features the area served by the company and the copy reads: "Manufacturers find their power costs much reduced when Shawinigan Power supplants steam power".

A remarkable story could be told about the work the Shawinigan group has accomplished in the development of industry in Quebec. This group of companies can be regarded as an outstanding example of what can be done under the guidance of good engineer-management. The Shawinigan organization and The Engineering Institute of Canada have always worked closely together. Currently every member of Shawinigan's professional engineering staff is a member of the Institute. From the ranks of Shawinigan have come E.I.C. officers for many years. These men know the field served by the *Journal* and have always insisted that advertising be placed in it to keep the name "Shawinigan", its products and services, before potential customers.

Elevators, Tanks and Castings

The Turnbull Elevator Manufacturing Co. commenced advertising in the December 1918 issue of the *Journal*. The first advertisement mentions passenger and freight elevators.

Another elevator advertiser was the **A.B. See Electric Elevator Company of Canada Limited** with offices in Montreal and Toronto.

In the same issue **The Toronto Iron Works Limited** have a half page advertisement which shows a huge metal tank being drawn on a sleigh by a team of horses. The copy features tanks, penstocks, bins and hoppers, blast furnaces, stand-pipes, stacks, and water towers.

This Company, too, has had long and continuing association with the members of the Institute through the advertising pages of the *Journal*. Today, as forty years ago, Toronto Iron Works Limited will be found in the advertising sections of selected issues.

Canadian Steel Foundries is another consistent advertiser to Canada's professional engineers in the December 1918 *Journal*. The advertisement offers "Acid and basic open hearth steel castings—ferro-alloy steel castings — manganese-steel trackwork". Here is another example of a Canadian company which will go down in history as one of the major contributors to the engineering work required to build a great nation.

Maritime Firms

In the October and November issues **Union Foundry and Machine Works Limited** of Saint John, New Brunswick offer their services in connection with "Mill, marine and pulp machinery of every description, iron and brass castings, ship work of all kinds". **Engineers and Contractors Limited** of the same city describe, in part, a job they recently completed — the Moncton bridge foundations at the Petitcodiac River. The copy reads in part "Tide 30 feet. Current 10 miles per hour. Pneumatic caissons sunk to rock 50 feet below low water, through silt, quick sand, boulders and clay. Complete information on this work in the Engineering Institute of Canada, *Proceedings* Feb. 22, 1917."

• **Advertisers 1918**

The president of the company was E. R. Reid, and E. M. Archibald the chief engineer.

The Maritime Bridge Company Limited of New Glasgow, Nova Scotia, advertised throughout the last months of 1918 to bring their products and services to the attention of E.I.C. members.

They offered "steel railway and highway bridges, buildings, girders, trusses, towers, turntables, tanks, smoke stacks, riveted pipe, and structural steel and plate work of all descriptions". It is of special interest to note that they claimed "the only complete stock of steel shapes, plates and bars in the Maritime Provinces."

Bedford Construction Company Limited, with offices in Halifax and East Saint John, N.B., emphasized their services as railroad contractors and listed as work on hand construction of dry dock and shipyards at Halifax, N.S., and of dry dock and shipyards and a breakwater at Courtney Bay, East Saint John.

Grant & Horne, of Saint John, N.B., engineers, contractors, and shipbuilders, used the last two issues of the 1918 volume to advertise the fact that they had constructed two buildings, one in 1916 and one in 1918 for T. McAvity and Sons Limited and an Imperial Munition Board ship the *War Fundy* in 1918.

It is interesting to note that in all these early advertisements the abbreviation "St." is used when mentioning Saint John, New Brunswick.

Restoration of Halifax

The Nova Scotia Construction Company, of Halifax, N.S., advertisement is headed "Hydrostone" and the copy ties in with the restoration of Halifax after the explosion. The copy reads, in part, "The Halifax Relief Commission have adopted this stone for the re-building of the restricted residential portion of devastated Halifax, making it a fire-proof district.

"This stone was adopted by the Commission on the advice of the architect after an extensive study of new town sites in the United States".

William Stairs, Son & Morrow Limited, established in 1810, and still very much to the fore as suppliers of tools, materials, paints, "hardware", etc.: advertised in the October issue. Their copy, too, makes reference to the reconstruction of Halifax, following the explosion. An extract from the advertisement is an indication of what was going on in the Nova Scotia capital at that time. "Halifax in the grip of reconstruction is a powerful magnet drawing to its doors Canada's Master Builders. It may be your turn next to come to Halifax. If it is, we stand ready to render you a service unsurpassed in Eastern Canada so far as supplying the prime and basic requisites for construction and reconstruction."

The Nova Scotia Government was, in 1918 as today, "advertising-minded" and in issues throughout the first volume they advertise the water and other natural resources of the province and the maritime transportation facilities adjacent to areas suitable for industrial development. **T. McAvity & Sons Ltd.** of Saint John, N. B. offer fire hydrants, gate valves, "World" brass valves "tested for STEAM working pressures to 250 lbs." It is of interest to note that this highly respected Eastern Canadian company as far back as 1918 had a

Vane Axial Fan

Utility Set

SHELDON FANS

Ventilating Fan

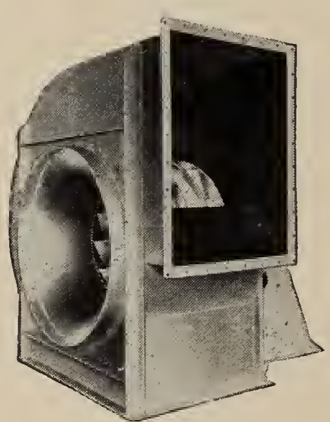
Stainless Steel Blower

Mill Exhauster

Mechanical Draft

Name your need for air . . . Ventilation . . . Comfort . . . Processing. To serve your purpose best, air must first be harnessed well. The total effectiveness of your air handling equipment is *only* realized when the *right* fan is used on the *right* job. No one Fan type can do all things. Sheldons, over the past sixty years, have designed and engineered the *complete* line of products to move and condition air. Consult our engineers. Together, we can work out the ways that air can be made to do a better job for you.

HEATING • COOLING • AIR CONDITIONING
VENTILATING • DRYING • PROCESSING



Sheldon Silavent Fan, Design 4

Designed primarily as a high efficiency ventilating fan. This unit also has ratings that fit requirements of high pressure air systems and forced draft applications in power plants. It is widely used as an industrial fan. Backwardly inclined wheels produce high static efficiencies over a wide range, resulting in low noise levels. Ask for Catalogue # 342.

Sheldon s

SHELDONS ENGINEERING LIMITED

GALT, ONTARIO, Montreal, Toronto, London, Ottawa, Hamilton

Representatives in all principal cities across Canada

30 A 82

coast-to-coast organization and offices in London, England, and Durban, South Africa. Many Canadian plants and mills, buildings, mines, vessels, homes, are today equipped with "T. McAvity" products. This company's long contribution to the development of Canada as a whole and to the welfare of the citizens of Saint John in particular must be in the nature of a record. This firm is still advertising, regularly, in the *Journal.*

Many of us are inclined to regard "reinforced concrete pipe" as something comparatively new. Yet, it is advertised, on page eighty of issue number one, by **Canada Lock Joint Pipe Limited** of Winnipeg, Manitoba. The advertisement describes a "66 in. pressure pipe for greater Winnipeg Water District with heads 45 ft. to 90 ft."

In current issues of the *Journal* "Renold Chains" are advertised by **Renold Chains (Canada) Limited.** In the May 1918 issue these products and "Morse" chains are offered by Jones & Glassco (Inc.), the predecessors of the present advertiser. The advertisement features "space-saving", "efficiency", "chain drives from ¼ h.p. to 5,000 h.p. in successful operation".

Construction and E.I.C.

The construction side of engineering is featured in the advertisements of **E. G. M. Cape & Co. Ltd.** who, in 1918 and until very recently, had head offices in the New Birks Building, Montreal. They now have their own building on Western Avenue, Montreal. In the May 1918 issue they feature the Ross Memorial Wing of The Royal Victoria Hospital, Montreal. The copy states: "The above building was erected by us. Other contracts recently completed include: The Lewis Building, Montreal; factory building for Northern Electric Co.; shipbuilding plant and launchways for Canadian Vickers; Liverpool and London and Globe Insurance Co.'s new building; Atlantic Sugar Refinery, Saint John, N.B.; reinforced concrete pattern store for J. Bertram & Sons Ltd., Dundas, Ont."

E. G. M. Cape & Company has enjoyed a long and successful career, and their personnel have remained very close to the Institute. Today, the founder of the Company, Colonel E. G. M. Cape, M.E.I.C., is chairman of the board, his son, Lt.-Col. John Cape, M.E.I.C., is vice-president, and Col. John Bertram Stirling, M.E.I.C., is president—and a very active past-president of the Institute. The words "Cape" and "construction" in Canada are synonymous and at regular intervals the advertising sections of the *Journal* are used to re-emphasize this fact.

Fine Papers

An all-Canadian paper manufacturing company used the 1918 issues to promote the sale of fine papers. The firm, **The Rolland Paper Co. Ltd.,** of Montreal. This old-established organization pioneered in the making of fine paper in Canada and in 1918, as today, discriminating paper users, looked for "The R Shield Watermark".

On the inside back cover of issue number one **Dominion Copper Products Company Limited,** with works at Lachine, Que., offered "seamless tubes, sheets and strips in all commercial sizes".

The "Dominion" Group

All the outside back covers in 1918 carried the advertising of **Dominion Iron and Steel Company Limited** of Sydney, N.S., and Montreal. The direct successors and affiliates of this Company are still advertising, regularly, in the *Journal* under the name of the **Dominion Steel and Coal Corporation Limited.**

Also in the 1918 issues are full-page advertisements of the **Nova Scotia Steel & Coal Company Limited** which offered products comparable with those of the Dominion Iron and Steel Company. In 1938 the Nova Scotia Steel and Coal Limited became a subsidiary of the Dominion Steel and Coal Corporation Limited.

Where would Canadian industry and transportation be today if these Maritime organizations had not produced and supplied iron, steel, coal, rails, plates, bars, wire, and the countless allied basic and manufactured products necessary for their completion and maintenance? There has always been a strong link between the maritime "Dominion" group and the Institute. The engineers of the companies in the organization have been active participants in E.I.C. affairs, one of the outstanding of these being our present president, C. M. Anson, M.E.I.C.

The Cook Construction Company Limited & Wheaton Brothers builders of the Halifax Ocean Terminals Railway advertised, in the October, November and December issues. This terminal work and the illustration showed the Tower Road bridge, Halifax, which has a 144 foot span over a cut 65 feet deep.

Cement Distribution

Canada Cement Company Limited commenced advertising in the *Journal* in the fall of 1918 and has been regularly represented in the advertising sections in all subsequent volumes. The 1918 advertisements state "Canada Cement can now be secured from over 2,000 dealers in nearly every city, town and village in Canada". The copy theme of the advertisement is concrete for highways with emphasis on the necessity for building roads capable of handling heavy, high-speed, commercial trucks.

Another current and consistent advertiser, whose *Journal* advertising commenced in the October 1918 issue, is **Jenkins Brothers Limited.** The advertisements featured "Valves, packings and mechanical rubber goods".

• Advertisers 1918

Through forty years this outstanding Canadian organization has been using space, on a regular basis, in the *Journal.* The Company has always had a reputation for quality service and there are very few mechanical engineering jobs, particularly where valves are concerned, when the name "Jenkins" does not occur to the consultant, the designer or the purchaser.

Western Advertisement

From the middle West came the advertising, during the middle months of the year, of the **Manitoba Bridge & Iron Works Limited** who offered structural steel, gray iron castings, plate work, bolts, rivets, and forgings. They referred to their reinforcing hydraulic upsetting and galvanizing plants. **McGreggor and McIntyre Limited** of Toronto advertised as structural steel and bridge builders and in addition to bridge work referred to roof trusses, tanks, hoppers, stair-work, fire escapes, and so on.

Wettlauffer Brothers Limited, of Spadina Avenue, Toronto, advertised in four mid-year issues offering contractors building machinery. There are two illustrations in the advertisements, one of a concrete mixer "of our famous heart-shape design" and the other of hoists "mounted with steam, gas or electric power".

First Printer

The printer of the *Journal* in 1918 was the **Modern Printing Company** of Dowd Street, Montreal. They were regular users of advertising space in the 1918 issue.

Water Cooling

From the United States came the advertising of **Spray Engineering Company** of whom the Canadian representatives were the "Rudel-Belnap Machinery Company Limited" of Montreal and Toronto. The advertisement claims "the Spraco System for cooling condensing water costs much less to install and operate than cooling towers". The copy then briefly describes the method of operation and refers to important users.

Wood Pipe

The Canadian Pipe Company Limited of Vancouver offers wire wound wood pipe "one inch to twenty-four inch" and continuous stave pipe "any size". Manufacture was in what was claimed as "the best equipped factory of its kind in Canada". Many of our developments owe much to the use of "woodpipe", and these pipe manufacturing industries have since taken advantage of improved production methods, new "glues" and other commodities. The story of the use of wood in engineering pre-dates history; it is still unsurpassed for many purposes, and Canada is still pioneering in its use.

Another firm offering wood stave pipe ("Michigan" Brand) was **T. A. Morrison and Company** of St. James Street, Montreal. Lumber, "by rail in carload lots from Nova Scotia and New Brunswick" was offered by **Dunfield and Company Limited** of Halifax and Saint John, N.B.

National Iron Corporation Limited with premises in Toronto, Port Arthur and Montreal offered cast ironpipe "every size for water, gas, culvert, or sewer".

In 1918, as in 1958, consultants and advisors offered their services to their fellow engineers by means of "professional cards" in the *Journal.*

• Advertisers 1918

The "Cards" in the 1918 issues are worthy of very special mention, not only because of the variety of service offered but because the illustrious Canadian engineers whose names are mentioned are truly among the most important of the builders of Canada.

Professional Cards

J. M. Robertson, offers services in the mechanical and electrical field. **Arthur Surveyer & Co.** (Arthur Surveyer and R. DeL. French) offers services in the civil field; **DeGaspe Beaubien** in the hydro-electric field; **Chipman & Power,** civil; **Dominion Engineering and Inspection Co.** list testing and inspection services covering a wide field and **Ewing, Lovelace & Tremblay** present themselves as civil engineers and land surveyors and offer reports, plans, estimates, etc. for industrial and municipal undertakings. **Walter J. Francis & Co.** were consultants for civil and mechanical projects and **R.S. & W.S. Lea** were in the water supply and drainage and sewage treatment field. **John S. Metcalf & Co.** advertise as designing and constructing engineers with emphasis on grain elevators, wharves and power plants. **Rudolph Hering,** of Broadway, New York—a member of the Institute—offered his services with respect to water supply, sewage and refuse disposal; **James, Loudon and Hertzberg Limited** of Toronto Street, Toronto, also advertised specialization in those lines as well as "incinerators, pavements, bridges and structural work including reinforced concrete and architectural engineering".

Featherstonhaugh & Co., patent attorneys, had professional cards in six issues of volume 1. Their addresses, in 1918, were Royal Bank Building, Toronto, and 5 Elgin Street, Ottawa. Their advertisements state: "The old established firm. Patents and Trade Marks everywhere".

Another firm which has made extensive use of the *Journal* throughout the years is **Milton Hersey & Co. Ltd.,** now located at 128 Elmslie Street, Montreal, and operating under the name The Warnock Hersey Co. Ltd. This organization has grown with Canada and now, as in 1918, is operating one of the best testing laboratories in the country. In their first advertisements they state: "The largest and best equipped commercial laboratories in Canada". "Established 27 years".

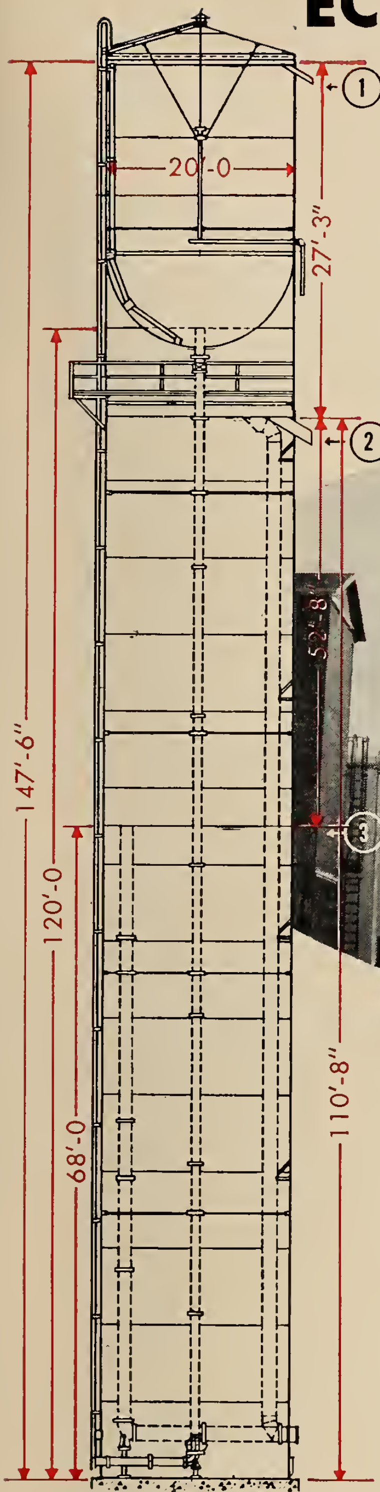
Marion & Marion used the first issues to advertise the fact that they could secure "patents promptly in all countries". Their address was 364 University Street, Montreal. This fine organization is still operating under the name **Marion, Marion, Robic & Bastien** and their principal address is 1512 Drummond Street, Montreal. Their advertising has appeared in the *Journal* almost without interruption since their first advertisement was published in the December 1918 issue.

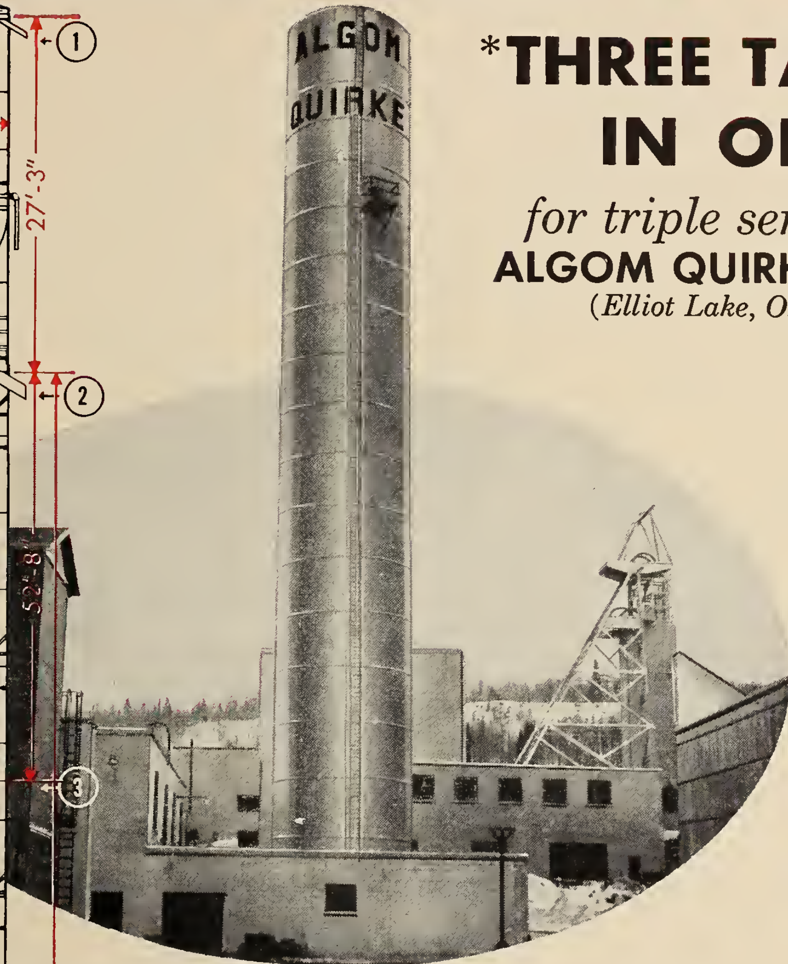
It is gratifying to learn through these advertisements that forty years ago, as today, Canada's leading engineering consultants were members of the Institute, and supporters and readers of its publication. Many of these early advertisers are still actively practising their profession and playing an unsurpassed part in the development of a great nation. Long may they be spared—long will they be respected and remembered!

Effective Presentation

Close scrutiny of the advertising
(Continued on page 254)

ECONOMY WITH T.I.W.





*THREE TANKS IN ONE

for triple service at
ALGOM QUIRKE MINES
(Elliot Lake, Ontario)

1. Water at top elevation to provide sprinkler reserve.
2. Water at elevation to provide domestic and mill elevated reserve.
3. Water reservoir to meet fire requirements. (In case of emergency the fire pump will boost water to an adequate pressure for fire-fighting.)

THREE TANKS IN ONE . . .
at half the price of three separate tanks

AN EXCEPTIONALLY ECONOMICAL T.I.W. INSTALLATION

*Patent applied for

STEEL PLATE PRODUCTS

ESTABLISHED
1907

THE
TORONTO IRON WORKS
LIMITED

TORONTO-MONTREAL

IN WESTERN CANADA-T.I.W. WESTERN LIMITED, EDMONTON, ALTA.

DESIGNERS • FABRICATORS • ERECTORS

* **Advertisers 1918**

pages of the *Journal* from 1918 to 1958 has failed to disclose a single advertisement which is not highly informative and in the best of taste. This scrutiny also showed that "advertised goods sell", because it is evident that the most successful firms in Canada are those which, year after year, have advertised through the media most directly connected with their sales prospects. To reach Canada's engineers, the best medium was and still is, obviously, *The Engineering Journal.* Apart from the benefits derived by the readers through informative advertisements there is another feature which cannot be overlooked—the revenue derived by the Institute through the sale of advertising space, which makes publication possible.

Production Costs

The cost of producing the *Journal* is greater than the revenue derived from a combination of membership fees and *Journal* subscription. However, like all other reputable professional "news-technical" periodicals, advertising is not accepted solely as a means of raising money, but rather to obtain the funds necessary to produce a Journal of the finest quality.

Production costs are comparable with those of any other "quality" periodical produced in Canada but in *The Engineering Journal* the percentage of non-revenue producing pages is much higher than the average. The advertising revenue enables us to produce a better publication—in the sense that we present two types of informative messages, advertising and editorial, both of which are important educational forces.

Low Rates

The advertisers are given good value for their money because even with today's high printing and paper costs the basic advertising rate—per page per thousand of circulation—is not much higher than it was twenty years ago. The maintenance of a high volume of advertising means that The Institute can continue to produce a publication of ever-increasing value and interest to the readers.

Every advertisement is carefully prepared and produced to give the maximum amount of information in the fewest possible words. Take advantage of this service and read the advertisements as they are intended to be read—as a source of authentic information.

Reader Service Cards

A few years ago the Institute decided to publish in each issue of the *Journal* "Reader Service Cards". They are in this issue. Make regular use of them and see what a wealth of information they will bring to you. The processing of these cards is one way in which the Institute can demonstrate the effectiveness and show its appreciation of the advertising in the *Journal* —the more they are used the greater the *Journal* will become!

Photographic Exhibition

1958 Annual Meeting

The collection of photographs shown at the 1957 Annual Meeting of the Engineering Institute was subsequently exhibited, from coast to coast. In addition to the showings at Canadian universities, the photographs were shown at Eaton's Montreal store in October. Despite the competition for the attention of the public, the exhibitions across Canada were very successful and another exhibition is planned for this year's Annual Meeting at Quebec, May 21, 22, 23.

Already, Journal advertisers have been invited, by letter, to participate. However, there are quite a few individual members of the Institute who are camera enthusiasts and they too may enter their photographs depicting engineering achievements of 1957.

***The rules are simple.* Each exhibitor may enter one or two photographs of engineering interest, preferably recording work done in 1957. The prints should be 8" x 10" or larger and mounted on standard 16" x 20" mounts. Larger mounts cannot be considered as they will not fit the travelling cases.**

Each photograph should have the following information suitably printed on the face of the mount; the title of the picture and the name of the member submitting it. Additional information and photographic data may be shown on the back.

***Awards of merit,* suitable for framing will be presented to the exhibitors of the five best photographs. The exhibition committee reserves the right to withhold from exhibition any photographs not considered suitable. All photographs submitted become the property of the Engineering Institute to be exhibited and published subsequently at the discretion of the Institute.**

***The closing date* for receiving photographs from individual members has been set at May 10th. Please mail photographs to:**

PHOTOGRAPHIC EXHIBITION
The Engineering Institute of Canada,
2050 Mansfield St., Montreal 2, Que.

Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

Gresham Transformers — Announced recently were the following three appointments to Gresham Transformers (Canada) Ltd., the Canadian subsidiary of Gresham Transformers Limited, England: C. C. Kent, president; H. R. Smith, vice-president; and N. E. Hale, director. Mr. Hale will also be retained as technical consultant.

Canadian Westinghouse — The Hon. Leon Methot has been elected to the board of directors of the Canadian Westinghouse Company Limited.

Marine Industries Limited — Recently announced was the appointment of A. Simard as vice-president of Marine Industries Limited. Mr. Simard joined Marine Industries in 1940 and was named director of personnel in 1942, which position he maintained until his appointment as vice-president.

United Steel Corporation — H. LeBel, formerly chief engineer, has been appointed assistant manager of the Canadian Mead-Morrison division of the United Steel Corporation Limited, following the retirement of R. T. Northcote, plant manager.

A. Simard

Bird-Archer Appointments — The Bird-Archer Company Limited, water treatment engineers, recently announced the following new executive appointments: H. C. Harragin, president since 1943, becomes chairman; E. L. Ruggles, M.E.I.C. vice-president and general manager since 1951, has been made president; J. E. Koyl, manager of railway and general chemical divisions since 1951, becomes vice-president.

Catalytic Construction Appointments — R. G. Peers and J. R. Nicholson have been named directors of Catalytic Construction of Canada Ltd.

Cominco — Recent appointments by The Consolidated Mining and Smelting Company of Canada Limited at Trail, B.C., are T. T. Dobie, JR.E.I.C., maintenance superintendent, phosphate plant, chemicals and fertilizers division, and C. H. Albright, materials handling engineer, yards and services, engineering division.

Canadian Aero Service Limited — Dr. Ta Liang has joined the consultants' staff of Canadian Aero Service Limited, Ottawa, and will direct the company's photo interpreters in their work for engineers and governments, and for the oil, mining and forest industries.

C-I-L Appointment — Canadian Industries Limited announce the appointment of H. G. Campbell to sales manager of their chemicals division; he succeeds G. D. Pratt who will serve as a sales consultant for the division. Also announced is the appointment of A. K. Cameron as manager, "Fabrikoid" division plant at New Toronto, Ont., succeeding W. H. Shaw who has been named special assistant to the division's general manager, D. S. Kirkbride, M.E.I.C.

Monsanto — J. H. Langstaff has been appointed product sales manager for general chemicals, and J. K. McCabe a technical sales representative for the plastics and resins sales department, Monsanto Canada Limited.

H. Lebel

C.G.E. Appointment—R. W. McDonnell has been appointed manager—advertising and sales promotion in Canadian General Electric Company's lamp department, Toronto.

Ex-Cell-O of Canada — James Harvie has been appointed to the new post of general sales manager of Ex-Cell-O Corporation's industrial sales organization in Canada, and will guide the sales operations of the industrial products of both Ex-Cell-O of Canada in London, Ont. and Colonial Tool Company, an Ex-Cell-O subsidiary in Windsor, Ont.; his headquarters will be in Toronto.

Shell Oil Company — A. R. Michell has been named manager, central division, purchasing-stores of the Shell Oil Company of Canada Limited, Toronto; he replaces N. V. Swail, who has been appointed Hamilton plant superintendent.

Sun Oil Company — The following appointments have been announced by Sun Oil Company Limited: K. F. Heddon, district manager, London, Ont.; C. B. Pitt, manager, wholesale and fuel oil departments, H. S. Ostrander, manager, industrial products department, G. R. Burns, technical representative, industrial products department, all of home office, Toronto; W. H. Sanson, manager, industrial products, wholesale and fuel oil departments, Toronto district office.

Business News

Power Transformers Order — The Aluminum Company of Canada has ordered sixteen big 55,000 kilovolt-ampere power transformers from the Canadian Westinghouse Company, Hamilton, for its Chute des Passes power generating development on the Peribonka River some 350 miles north of Quebec City. The transformers will step up the generator voltage of 13,800 volts to a high voltage of 380,000 volts for long-haul transmission to Alcan smelters at Isle Maligne, P.Q. The transformers are said to be the most powerful yet built in Canada to use aluminum windings in place of conventional copper. They will stand over 24 feet high and will each weigh more than 110 tons.

Change of Location — Foundation of Canada Engineering Corporation Limited recently announced movement of its head office in Toronto from the Manufacturer's Life Building to establish single occupancy at 8 Spadina Road. Fenco also maintains offices in Montreal and Vancouver.

Shawinigan Subsidiary — St. Maurice Chemicals Limited is to become wholly-owned by Shawinigan Chemicals Limited under a plan announced recently. At present the St. Maurice company is owned jointly by Shawinigan Chemicals, itself a wholly-owned subsidiary of The Shawinigan Water and Power Company, and by Heyden Newport Chemical Corporation, of New York. To carry out the purchase, The Shawinigan Water and Power Company, subject to approval of the Provincial Electricity Board, proposes to issue 75,000 additional common shares to exchange for Heyden Newport's 50 per cent interest in St. Maurice Chemicals. Shawinigan Water and Power then plans to transfer this interest to Shawinigan Chemicals in exchange for additional Chemicals common stock.

Federal Public Works Contracts — According to a statement authorized by Works Minister Green contracts involving expenditures totalling $7,253,452.56 were awarded by the Federal Department of Public Works during the month of February, 1958. The amount for new works in building construction and harbours and rivers engineering is $6,753,397.56; for the repair and maintenance of existing structures $25,055.00; and for the extension of the Mackenzie Highway $475,000.00.

THE ENGINEERING JOURNAL

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Associate Editor: Garnet T. Page

Assistant Editor: Margaret Griffin — Technical Editor: Peter C. Bell — Assistant Editor (Production): Namona Thorley

Publication and Advertising Manager: E. J. Blandford

Advertising Production Supervisor: E. McAllister — Circulation Supervisor: Christina M. Abraham

Advertising Offices: Listed in advertisers' index

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vol. 41 no. 5

Cables: Enginst-Montreal

PRINTED IN TORONTO

Price $6.00 a year in Canada, British Possessions, United States and Mexico, $7.50 a year in Foreign Countries. Current issues, 75 cents a copy, back issues from $1.00 per copy up. To members and affiliates, 50 cents a copy, $4.00 a year.—Authorized as second class mail, Post Office Department, Ottawa.

MEMBERSHIP

ABC CCAB BNA

Indexed in The Engineering Index

(19,200 copies of this issue printed)

MEET THE AUTHORS

R. David, M.E.I.C., District Engineer, Canadian Institute of Steel Construction, Inc., Montreal. *(Composite Construction of Bridges Using Steel and Concrete.)* Mr. David graduated from Paris University in 1912, (B.Sc.). He served in the French Armed Forces, 1914-1918, and graduated from the French Govt. Engineering School, Ecole Centrale Paris, in 1921. After 26 years of French government public works service overseas he came to Canada in 1947: he has held his present position since 1953.

G. G. Meyerhof, M.E.I.C., Head, Department of Civil Engineering, Nova Scotia Technical College, Halifax, N.S. *(Composite Construction of Bridges Using Steel and Concrete.)* An honours graduate in civil engineering from London University, (later a Ph.D.) Dr. Meyerhof worked for several years with consulting structural engineers in England. In 1948 he joined the staff of the British Government Building Research Station, and for his research on soil mechanics and foundation problems was awarded the degree of Doctor of Science in 1954 (U. of London). On coming to Canada Dr. Meyerhof joined the Foundation of Canada Engineering Corporation; he is the author of several papers.

P. K. Peterson, Chief Equipment Engineer, Orenda Engines Limited, Toronto. *(The Altitude Test Facility at Orenda Engines Limited.)* Mr. Peterson served as an engineer officer in the R.A.F. during World War II, after which he joined the Bristol Aeroplane Company on research and development of performance and mechanical aspects of early propeller-jet and turbo-jet engines. In 1951 he joined the gas turbine division of A. V. Roe Canada which later became Orenda Engines Limited. For three years he has been responsible for design of a wide variety of test rigs, test facilities, and instrumentation.

Three co-authors (l. to r. below), C. B. Cowan, W. S. Peterson, and G. L. Osberg, contributed to the paper *Spouting of Large Particles.*

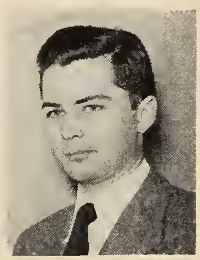
C. B. Cowan, Imperial Chemical Industries Ltd. A graduate of the University of St. Andrews (B.Sc., Hons. chemistry, 1948; Ph.D., 1952, Dr. Cowan spent the period September 1955 to September 1956 on leave of absence from I.C.I. at the Division of Applied Chemistry, National Research Council, Ottawa, Ont., on a postdoctoral fellowship.

W. S. Peterson, Division of Applied Chemistry, National Research Council, Ottawa, Ont. Mr. Peterson graduated from the University of Alberta, B.Sc., chemical engineering, 1942, and M.Sc., 1944; he joined the chemical engineering section of N.R.C. in 1944.



G. L. Osberg, Division of Applied Chemistry, N.R.C., Ottawa, Ont. Dr. Osberg graduated from the University of Alberta in 1939 (B.Sc., chemical engineering) and obtained a Ph.D. in physical chemistry at the University of Toronto in 1949. He has held his present position since 1949.

R. R. Keith, M.E.I.C., P.Eng. Assistant General Manager in Charge of Operations, Saskatchewan Power Corporation, Regina, Sask. *(Saskatchewan River Generating Station of Saskatchewan Power Corporation.)* Attended University of Saskatchewan (B.Sc., mechanical engineering, 1937). Mr. Keith has been continuously associated with the Saskatchewan Power Commission and the Saskatchewan Power Corporation since 1937. He has held positions at Saskatoon Generating Station, North Battleford, and Prince Albert; he became Power Production Superintendent in 1952, and has held his present position since 1956.



G. D. Campbell, JR.E.I.C., Director of Technical Services, Canadian Good Roads Association, Ottawa, Ont. *(The AASHO Road Test).* Dr. Campbell graduated from the University of Manitoba in 1951, and in 1952 received an M.S.C.E. degree from Purdue University. After two years with the Trans-Canada Highway Division, Department of Public Works, he did post-graduate work at Purdue University (Ph. D., highway planning and economics, 1956). In June 1956 Dr. Campbell became Engineer-Observer for the Canadian Good Roads Association at the AASHO Road Test in Ottawa, Illinois, and recently returned to CGRA headquarters in Ottawa, Ontario, to assume his present position.

H. L. Johnston, M.E.I.C., Chief Engineer, Du Pont Company of Canada (1956) Limited, Montreal. *(Evaluating Performance in an Engineering Department.)* Mr. Johnston served with the Canadian Engineers and Imperial Artillery from 1915 to 1919; he was mentioned in Dispatches and awarded the the Military Cross. He attended the University of British Columbia and McGill University and graduated from the latter in 1927 (B.Sc., civil engineering). After early experience on railway construction and land surveying he was commissioned B.C.L.S. 1924. Mr. Johnston joined Bremner Norris in 1927; from 1928 to 1936 he was plant engineer with Canada Paper Company and became a project engineer with Canadian Industries Limited, Montreal. From 1936 to 1953 he held many senior positions with C-I-L and was appointed to his present position on the separation of C-I-L and Du Pont in 1953.

COVER PICTURE

On April 5th, 1958, two-and-a-half million pounds of explosive were used to demolish the top of Ripple Rock. The cover picture was taken several seconds after the detonation of the explosive in the successful attempt to remove this hazard to navigation. Further information on Page 96.

Photo: Basil King, Columbian Photographers

• This Hoffman Kiln is constructed entirely of refractory concrete. Tunnel is 164 feet long and 8 feet wide. Average thickness of arch is 8 inches. Seven bags of Ciment Fondu per cubic yard were used. Aggregate old firebrick, 30% alumina graded 0.6 in. to dust. Immersion vibrators were used. All vertical forms were removed three hours after placing. The arch forms were removed between 12 and 24 hours after placing. A recent visit revealed that after working one year, the kiln is as new.

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Composite Construction of Bridges Using Steel and Concrete

R. David, M.E.I.C., *District Engineer, Canadian Institute of Steel Construction, Inc., Montreal*

G. G. Meyerhof, M.E.I.C., *Head, Dept. of Civil Engineering, Nova Scotia Technical College*

Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June 1957.

Revised paper received 19 August 1957

The paper briefly summarizes the history of composite construction and presents the main design aspects and construction procedures, with special reference to bridges. Methods of analysis are outlined to compute dead and live load stresses, failure loads and to determine the effects of shrinkage, creep and temperature. It is shown that the difference between the thermal expansion co-efficients of concrete and steel may be an important factor, especially in continuous structures exposed to the elements. The merits of various shear connectors are briefly discussed and the methods of prestressing composite structures are indicated.

COMPOSITE construction consisting of structural steel members working in conjunction with the surrounding concrete seems to have been used before ordinary reinforced concrete. The Melan system, which consisted of steel beams encased in concrete, was used extensively both in Europe and in the United States during the last decades of the nineteenth century. In France, rigid lattice frameworks, to which the form-work was fixed before concreting, have been used since 1890.

In Canada, tests on "steel beam and slab construction" were made at McGill University in 1923[1].

This early work, together with other research in Europe, led to an interesting development. The sponsoring steel fabricator developed a comprehensive system of composite construction, known as the Kane System of Composite Construction[2]. In building construction this took the form chiefly of latticed beams and columns surrounded by concrete, but it applied equally as well to solid beams and columns in buildings and bridges. Several large buildings and some bridges have been built of such construction in and around Montreal between 1934 and the beginning of World War II.

In 1937 a series of tests on concrete slabs on steel beams were conducted at the University of Toronto[3] under the auspices of the Canadian Institute of Steel Construction. These tests gave an indication of the combined strength of concrete slabs bearing on top of steel beams with and without shear connectors as well as with partial encasement of the steel beams. They also proved the efficiency of shear connectors as a means of increasing the bond between steel and concrete.

As a result of this work design methods were established in Canada for concrete slab and steel beam construction and governing clauses were incorporated in the National Building Code of Canada (1941). Such construction has been used to some extent in buildings, but it is only since World War II that its use has been extended to bridges other than those built earlier in Montreal. The general use of composite construction in bridges on this continent has been made practical by some interesting research at various universities in the United States on the subject of shear connectors[4].

General Design Considerations

The original tests made in Canada together with tests made recently in the United States and Europe[5] have shown that whenever a heavy concrete slab rests on a steel member, to which it is not purposely anchored, it reacts as a composite member to stresses induced by superimposed loads. Bond and frictional stresses within working limits are such that any strain of the steel girders is identical to that of the concrete along the contact surface of the two materials. Thus any calculated stresses which entirely ignore composite action do not correspond to the actual stresses.

For this reason, when a concrete slab and a supporting steel member are being considered, a design utilizing composite action is the logical solution. It is also much more economical. The design procedures for dead and live load stresses are well known and do not differ appreciably from reinforced concrete computation. An example is given in the Appendix. Design criteria may be different for bridges than it is for buildings. It is the purpose of this paper to present some of the important factors in composite bridge design and construction.

Factors Influencing the Design of Composite Bridges

Specifications— As no Canadian specification relating to composite bridge design has as yet been formulated, engineers in Canada are generally following the A.A.S.H.O. Specification (1953) though only a short paragraph in it refers to composite construction.

The designer will find it useful to study the new German tentative bridge design specification DIN 1078 (1955) (English translation)[6], which follows an extensive study of composite construction in a number of universities. Considerable information may also be found in many papers published by the University of Illinois.

Factor of Safety and Ultimate Load

As calculated according to the A.A.S.H.O. Specifications, composite bridges have a factor of safety (ultimate load in terms of live load) varying from 5 to 6 or even higher if diaphragms are riveted or bolted with high-strength bolts or welded to the stringers so as to form a rigid grid system, which is mainly responsible for the exceptional toughness of such a structure. The exact computation of the stresses involved in a composite structure with rigid diaphragms is almost impossible except by electronic computers, but it has been shown by tests[7] on bridges with spans from 100 to 200 feet that observed stresses vary from 35 to 60 per cent of calculated stresses. Similarly, for short spans (40 to 100 feet) deflections vary from 20 to 30 per cent of calculated deflections, and for longer spans (200 to 300 feet) about 50 per cent of the calculated deflections are generally recorded.

On the other hand, studies based on complete plastification of the section and tests up to failure using proper shear connectors indicate that failure loads can be predicted accurately and that the neutral axis shifts toward the plane of separation of the two materials during the process of plastification[8].

Calculation of Dead and Live Load Stresses

The magnitude of the dead and live load stresses at any section of a composite member will depend not only on the relative stiffnesses of the steel and the concrete components but also whether the steel beam is shored during the construction of the slab. For this reason it is the responsibility of the designer to decide whether or not shoring is to be used during erection. If shoring is used, both dead and live load stresses are computed on the basis of the composite section. Without shoring, the dead load stresses are calculated on the basis of being carried by the steel beam only and to these are added the stresses due to loads imposed after the concrete has set and which are calculated on the basis of composite action.

Residual and Incidental Stresses

The determination of residual stressess due to shrinkage and creep in the concrete and those due to possible difference of slab and beam temperatures are problems of some difficulty (see Fig. 1) and, as a rule, have been evaded or at least have had superficial examination. When shoring is used to support a steel member, the effect of plastic flow or creep due to a continuous compressive stress on the concrete due to dead load may be a factor worthy of consideration.

The effects due to the difference between the thermal expansion of steel and various kinds of concrete are important, but have been almost entirely overlooked on the assumption that the relative expansions of steel and concrete are about the same.

Concrete growth due to chemical or physical modifications has also to be considered since its possibility presents a serious problem whenever such concrete is used for a structure.

Stresses Due to Shrinkage, Creep and Relative Temperature Differences

Concrete shrinkage strain is taken as equal to 1×10^{-4}, and this value can be considered as a maximum if the slab is divided transversely into a certain number of sections which are allowed to set separately.

When shoring is used to support the steel member the effect of plastic flow or creep due to a continuous compressive stress in the concrete upon removal of the shoring should also be considered. This creep amounts to an equivalent contractual strain of about 2×10^{-4}.

Careful consideration of the stresses involved may suggest that shoring is unnecessary and uneconomical since the failure load with shoring is almost the same as that developed when no shoring is used. This is due to redistribution of stresses in the steel beam, which has little effect on the final plastic moment capacity of the beam.

Shoring will, however, be of interest when the composite section is prestressed by erection means, as described later; in which case the higher permanent compression in the concrete may create strains due to creep of relative importance in the order of 2×10^{-4}.

During a sudden rise in temperature, a steel beam may be warmer than the connected concrete slab due to a quicker temperature stabilization of the steel. This kind of temperature differential will create an additional strain of 1×10^{-4} which should be considered in stress computations.

Some authorities advocate compensating for stresses due to temperature differential by using different values for the modular ratio n. For example, they use $n = 10$ for live load calculations and $n = 20$ to 30 for dead load calculations in order to compensate for the effect of possible difference in slab and beam temperatures of $\pm$ 30°F. with $n = 30$, the estimated stresses are relatively lower in the concrete slab and higher in the bottom flange of the steel beam.

On the contrary, experimental studies and true analysis of these effects show that relatively high stresses are found along the plane of contact between the two materials where stresses are developed to compensate for potential strains since none can take place at that plane.

The net combined effect of shrinkage, creep, and temperature differential between cold concrete and warmer steel, involves potential tensile stresses in the concrete, an increase in the compressive stresses in the top flange of the beam and a slight increase in the tensile stress in the bottom flange of the beam.[9]

An example given in the appendix shows that their effect on the final distribution of stresses is of relative importance.

Stresses Due to Difference Between The Thermal Expansion of Concrete and Steel (Fig. 1)

(Hereafter the word expansion will be used in a general sense and then might be positive or negative.)

Since concrete is closely associated with steel structures, as well as composite structures, and forms the bulk of reinforced concrete and prestressed concrete structures, it is of importance to be aware of some physical or chemical changes which affect the linear dimensions of concrete and increase stresses to such an extent that failure may occur.

The effect of the difference between the thermal expansion of concrete and steel has not been given the attention by designers that it warrants. As gravel concrete aggregates were generally used at the beginning of reinforced concrete construction and these had practically the same coefficient of thermal expansion as steel (6.5×10^{-6} per °F.), it led to the general belief that concrete has the same thermal

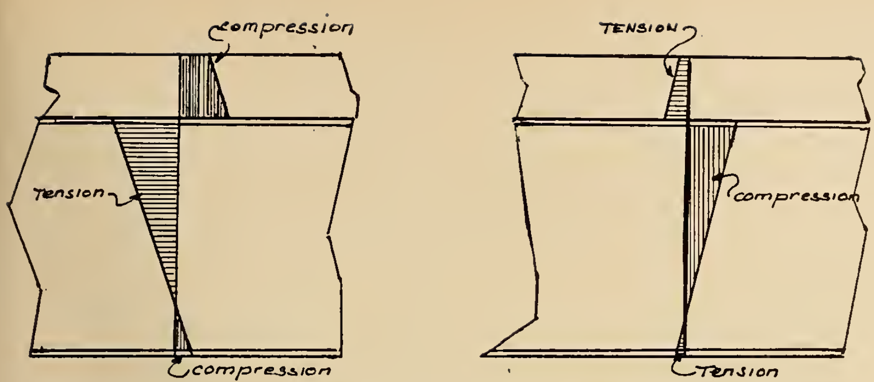


Fig. 1. Left: diagram of stresses due to thermal expansion difference between concrete and steel (between 70°F. and −40°F.).

Right: diagram of stresses due to concrete shrinkage or creep.

expansion regardless of the choice of aggregates and of cement. Thermal expansion of concrete above 32°F. has been thoroughly studied in England at the Building Research Station[10]. The coefficient of thermal expansion has a tendency to diminish under freezing conditions.[11]

Table I. Coefficient of Thermal Expansion of Concretes with Different Aggregates above 32°F.

	Coefficient per °F. $\times 10^{-6}$	
Aggregates	Air Storage	Wet Storage
Gravel	7.3	6.8
Granite	5.3	4.8
Quartzite	7.1	6.8
Dolerite	5.3	4.7
Sandstone	6.5	5.6
Limestone	4.1	3.4
Portland Stone	4.1	3.4
Blast Furnace	5.9	5.1
Foamed Slag	6.7	5.1

University of McGill tests[12] on thermal expansion of concrete at low temperatures have shown that Montreal limestone concrete has a thermal expansion which varies from 3.5 to 2.32 x 10^{-6} when temperature varies from 70° to -30°F.

As extreme climatic conditions exist in most sections of Canada, the possible effects of differences of thermal expansion of the concrete and steel may become critical, hence they have been studied in an example of a composite beam given in the Appendix. This study shows that a thermal expansion difference at low temperatures produces compression in the concrete, tension in the top flange of the steel beam, and compression in the bottom flange. The resulting negative bending moment may be as large as the total positive moment at this section due to the dead and live loads. Thus, in the case of simple beams, a difference of thermal expansion between concrete and steel, at low temperature, diminishes the maximum steel stresses while it increases the concrete stresses. It is important to note however that in the case of continuous steel beams with continuous concrete slabs the high tensile stresses developed in the top flange have to be added to the tensile stresses due to the negative bending moment in sections above the intermediate supports. Apart from large flange stresses, the stresses in the web may also become critical at these supports where bending and large shearing stresses combine. For these reasons it is considered that a gap of 2 to 3 inches should be provided between the concrete slabs resting on two consecutive spans and that shear connectors are unnecessary where negative moments occur. In the latter case these moments are resisted only by the steel beam. A continuous slab should be used only if the steel and the concrete have approximately the same coefficient of expansion.

Stresses Due to Possible Concrete Growth

Extensive field and laboratory work have investigated causes of concrete growth. Recently the Canadian National Research Council has made a very important contribution on this subject which is a valuable source of information.[13]

Concrete growth may be due to physical causes such as freezing-thawing, wetting-drying, heating-cooling, etc. Chemical causes are specially due to the fact that alkalies released during hydration of high-alkali Portland cements react with certain rocks and minerals of aggregate with consequent expansion and ultimate deterioration of the concrete. Tests on mortar bars containing high- or low-alkali cement and many different samples of common rocks and minerals crushed to form the aggregate showed that after twelve months storage at 100°F. linear expansion ranged from nil to more than 3 per cent. The studies showed that all silicate and silica minerals react with alkalies in Portland cement, but fortunately, the greater number react only to an insignificant extent. Expansion at any given age tends to increase with alkali content of the cement, temperature during aging, moisture availability, cement content of the concrete or mortar and amount, size and radioactivity of the aggregate.

Concrete growth will cause stresses in composite bridges similar to that produced by differences in thermal expansion coefficients of steel and concrete at low temperatures.

The growth is generally a very slow process, the amount of which is unpredictable in most cases, but with certain cement-aggregate combinations it can be very serious.

Thus it is extremely advisable to circumvent any long-term adverse effects by choosing a concrete mix that is composed of low-alkali cement and chemically inert aggregate, on which freezing-thawing and wetting-drying cycles have very little effect.

Shear Connectors (Fig. 2)

Although it has been demonstrated by tests[14] that there is considerable bond strength between the unpainted surface of the top flange of the beam and the concrete slab, which is capable of transmitting horizontal shear causes by static loads, further research[15] has indicated that severe impact loading may destroy this bond and thus composite action would cease. For this reason in bridges, the beam and the slab are interconnected by means of shear connectors which are designed to transmit the full horizontal shear as well as prevent both vertical and horizontal movement of the slab relative to the beam.

Shear connectors may be either rigid, semi-rigid or bond type. All have recently been the subject of numerous tests at various universities all over the world.

Rigid connectors are relatively inflexible and remain so at ultimate load capacity. Semi-rigid connectors are somewhat more flexible and will generally yield before crushing of the concrete occurs. Bond connectors, as the name implies, depend entirely on bond stresses to develop anchorage.[16] Numerous forms have been devised, including spirals.

Among semi-rigid connectors are to be found both the channel type and the steel stud. University of Illinois tests[17] have proved that when either type is properly designed and used, the ultimate bending capacity of the composite section is reached before shear failure occurs.

Permissible compressive stresses and bond stresses will depend on concrete strength. It is important to have proper spacing between consecutive shear connectors so as to develop the pressure on the largest possible section of the concrete and also avoid any shearing plane in the concrete both longitudinally and tangentially to the shear connectors.

The amount of longitudinal shear which must be taken into account will include that produced by the dead loads (if shoring is used), live loads, shrinkage, creep, temperature difference, and any difference between the thermal coefficients of expansion of the slab and the beam.

From numerous tests it has been shown that if shear connectors are properly designed, composite beam failure is due only to ultimate compressive stress in the concrete slab or full plasticity in the steel beam, or both combined.

It is the responsibility of the designer to state which type of shear connector is to be used. However, there are many variations of each main type. In the interest of economy it is advisable to allow some latitude in this respect so that the fabricator might suggest the shear connector best suited to his facilities.

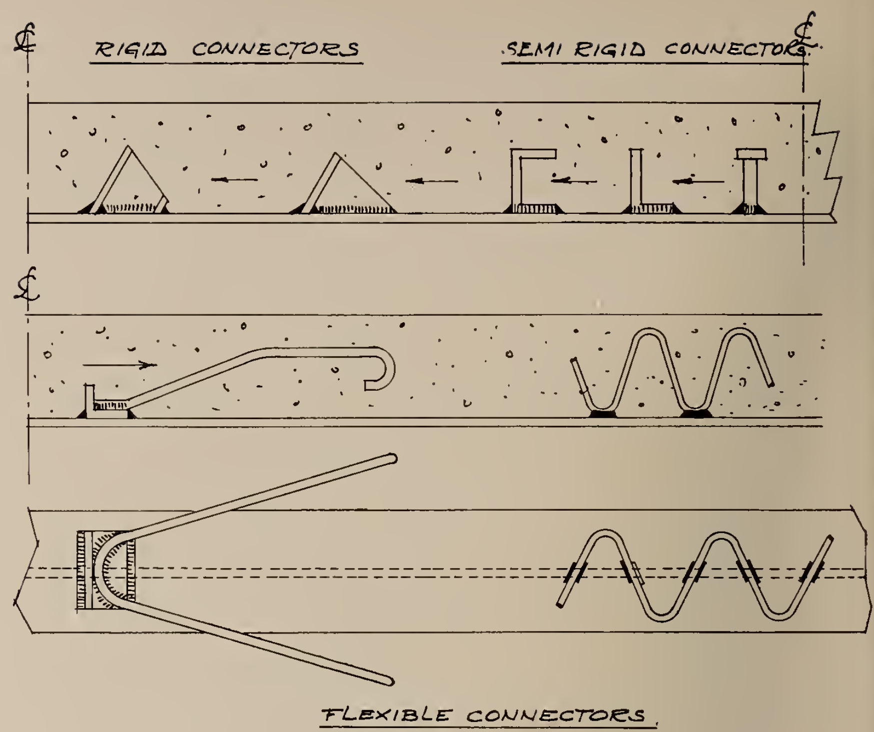


Fig. 2. Shear connectors.

Prestressing

The Reasons for Prestressing — Prestressing of the steel beam is sometimes done in order to produce stresses of opposite sense to those that are anticipated during the application of dead and live loads. Therefore the net bending moment at any section is usually less under design load conditions than would be the case where no prestress was applied. Hence design based on allowable unit stresses generally results in the utilization of a smaller section where prestressing can be employed and therefore some economy may be gained if the cost of prestressing is less than the cost of the material saved.[18]

The computed deflection of composite bridge girders is usually in the order of L/1200 to L/1400 and observed deflections are often in the order of 50 per cent of these values. Since the limiting deflection in bridge specifications is generally about L/800 there appears to be a saving in weight of steel of 15 per cent to 30 per cent if the composite section is chosen on the basis of the limiting deflection. However, in order that allowable unit stresses are not exceeded in such a section, prestressing may be necessary.

Prestressing the Structural Steel During Erection

In simple span construction prestressing may be accomplished by shoring approximately the middle third of the steel beam to some elevation higher than the elevation of the end bearings and then forcing both ends of the beam back onto the bearings, in effect compressing the bottom flange and tensioning the top flange. The concrete slab is then poured and allowed to cure before the shoring is removed. The composite section then has a "built-in" prestress of opposite sign to stresses caused by dead and live loads.

Erection prestressing procedures for continuous spans depend on the number of spans that are continuous, but usually involve producing temporary differences of level on the different piers. In general, mid-span moments will increase while moments over supports will decrease. However, since support moments are usually carried by the steel only, some economy of steel is therefore realized (Fig. 3).

Prestressing the Concrete Slab

Lateral prestressing of concrete slabs of composite bridges has been done in this country. It reduces the weight of the slab when the stringers are widely spaced. Concrete slabs of continuous composite construction bridges have also been prestressed longtitudinally over the supports to ensure that the concrete does not come under tension and thus lose its effectiveness in the composite section.

Although prestressing of the slab can result in some economy of material, the extra work involved always offsets this to some degree.

Maintenance Aspects

For composite bridges to withstand the extreme climatic conditions in Canada, it is considered desirable to apply bituminous wearing surface so as to avoid bad effects due to freezing and thawing. Steel stringers should be painted and not encased in concrete since this increases the weight, and the overall economy is correspondingly diminished. Concrete never protects perfectly against corrosion since cracks appear after a few years and it is practically impossible to prevent corrosion once air and moisture have this means of access. Trucks can readily be equipped with paint guns, power-driven rotary steel brushes, nylon nets to permit easy inspection of the road surface and the expansion joints. Maintenance costs can be reduced to a minimum if periodic inspection is undertaken at reasonable intervals.

Economic Considerations

The matter of economy is of paramount interest to a designer and owner in the consideration of the use of composite construction for bridges. Since the cost of shear connectors, together with the extra welding involved, is not negligible, composite construction is generally more economical for medium spans (above 40 ft.) and long spans. Many comparative designs have proved its economy in such bridges, especially in connection with expressway overpasses and elevated highways. However, composite design is often chosen for the additional advantages of unusual flexibility, rapidity of construction and the lack of shoring which permits the free movement of traffic during construction. All of these again contribute to the overall economy of the project.

Generally, a steel beam with a cover plate over two-thirds of its length and welded to the bottom flange constitutes the most economical composite beam. Built-up sections and Canadian sections can be used effectively. When shoring is used its advantage is somewhat offset by the additional stresses due to creep, which need not be considered for unshored beams.

If calculated elastically and shored, a composite steel beam will be 15 to 25 per cent lighter than a steel beam with no composite action. A composite steel beam with a built-up bottom flange may be as much as 30 to 40 per cent lighter.

When shoring is not used, the economy in the beam design may be less. It depends on the ratio of live load to dead load and may be anywhere between 8 to 35 per cent. However, shoring costs are eliminated.

If a plastic analysis is made, there is practically no difference at failure load between identical shored and unshored composite beam. The only difference is the deflection under working load which is slightly larger with unshored beams. This is usually of little consequence since deflections of composite beams are small. It seems likely that when all aspects are considered, unshored composite construction will generally be more economical, unless the shoring is to be also used as a means of prestressing.

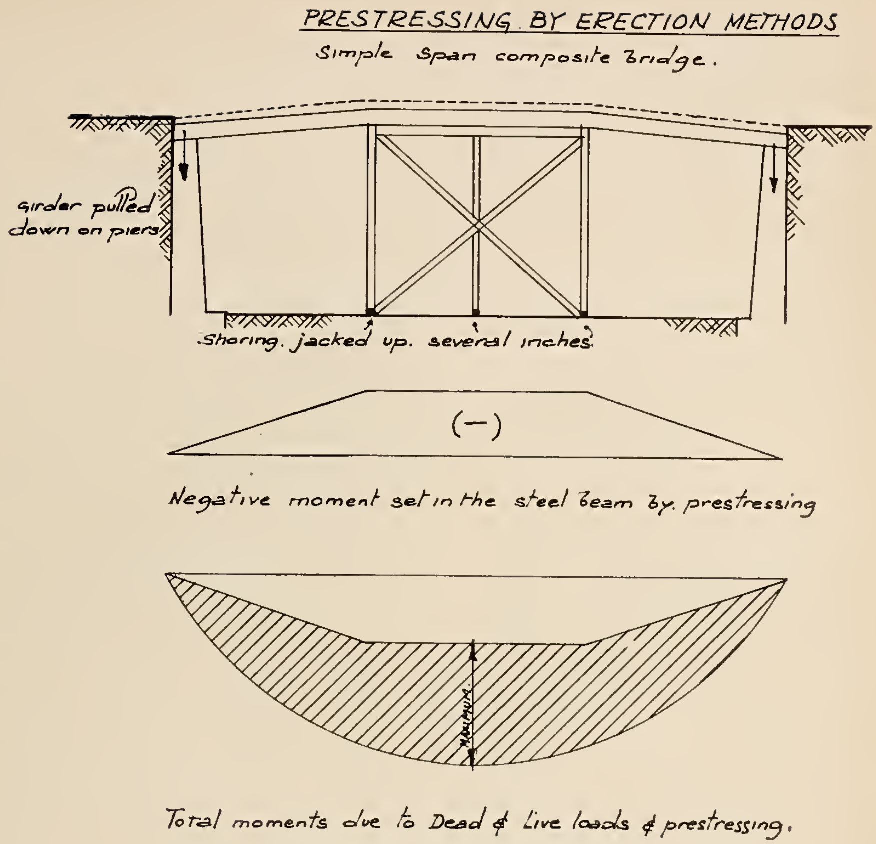
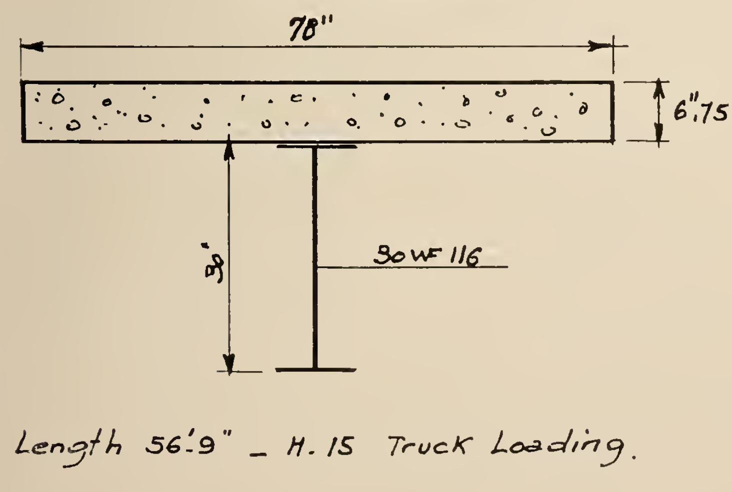


Fig. 3. Erection prestressing.

Conclusion

The use of composite action between structural steel beams and concrete slab bridge decks, provides a rapid and economical means of construction.

Fig. 4. Composite beam.



Structural design is generally less complicated than similar designs using reinforced concrete and involves only slightly different calculations than those used in ordinary steel design. The "extra" factors such as creep, shrinkage and differential thermal contraction stresses that are indicated in this paper, as well as possible concrete growth, are not unique in composite construction but exist in varying degrees in all bridges where steel and concrete are combined in some manner. The lack of recognition accorded these factors in the past has at times resulted in disastrous consequences.

Construction procedures are no different than are common to ordinary "beam and slab" construction.

The last ten years have seen an ever-growing number of bridges and elevated expressways utilizing composite action in order to achieve simplicity, harmony and economy.

Economy has been gained not only in savings in materials combined with simple erection techniques, but also due to simplified traffic handling made possible by the absence of shoring.

Composite construction is worthy of consideration for any bridge project and, with intelligent design, will prove itself effective and economical.

APPENDIX

Example of Analysis of Simply-supported Composite Beam

1. Properties of Section (Fig. 4)

(based on paper by N. M. Newmark and C. P. Siess in *Public Roads*, 1943, vol. 23, p. 157).

Concrete slab:
area $A_c = 527$ in.^{2},
moment of inertia $I_c = 1980$ in.^{4}

Steel beam:
area $A_s = 34.1$ in.^{2},
moment of inertia $I_s = 4920$ in.^{4}
section modulus $S = 328$ in.^{3}.

Composite section:
overall depth $D = 36.75$ in.,
thickness of slab $t = 6.75$ in.,
depth of neutral axis $d = 10.6$ in.,
moment of inertia (eff. steel)
$I = 12120$ in.^{4}

Modular ratio $n = 10$.

2. Dead and Live Load Stresses at Mid-Span (Fig. 5)

Dead load moment (60 ft. span)
$M_d = 3215$ kip.-in.

Live load moment (AASHO H15 load)
$M_l = 3470$ kip.-in.

Dead load stresses:
Concrete stresses $f = 0$
Steel stresses (beam only)
$f = M_d/S = \pm 9800$ p.s.i.

Live load stresses:
concrete stress top of slab
$f_1 = M_l d/nI = -304$ p.s.i.
Concrete stress bottom of slab
$f_2 = M_l(d - t)/nI = -111$ p.s.i.
Steel stress top flange:
$f_3 = nf_2 = -1110$ p.s.i.
Steel stress bottom flange
$f_4 = M_l(D - d)/I = +7480$ p.s.i.

Sum of dead live load stresses:
$f_1 = -304$ p.s.i., $f_2 = -111$ p.s.i.,
$f_3 = -10910$ p.s.i., and
$f_4 = +17280$ p.s.i.

3. Computation of Stresses Due to Shrinkage, Creep, Temperature Difference Between Slab and Girder, Thermal Expansion, Difference of Thermal Expansion at Low Temperatures and Concrete Growth (Fig. 6).

Their effects on composite structures are identical though producing either tension or compression.

Let ϵ be the difference of elongation produced by any of the above mentioned causes, between slab and girder if both materials were free to expand. Since this is not the case, two identical forces N_s and N_c ($N_s = N_c = N$) must be applied at the centres of gravity so that the corresponding strains ϵ_s and ϵ_c are such that

(1) $\epsilon_s + \epsilon_c = \epsilon$

Since no strain can occur in the plane of separation concrete-girder, ϵ_s and ϵ_c have to be substituted by corresponding stresses.

$$\epsilon_s = \frac{1}{E_s}\left[\frac{N}{A_s} + \frac{M_s \cdot C}{I_s}\right]$$

$$\epsilon_c = \frac{1}{E_c}\left[\frac{N}{A_c} + \frac{M_c \times t/2}{I_c}\right]$$

$M_s = M_c = N \times$ d (no external moment)

$$\frac{M_s}{E_s I_s} = \frac{M_c}{E_c I_c}$$

(composite action = identical slope for strains)

Substituting and solving for N

$$N = \frac{\epsilon}{\left(\frac{1}{A_s E_s} + \frac{1}{A_c E_c} + \frac{d^2}{E_s I_s + E_c I_c}\right)}$$

$$M_s = E_s I_s \cdot \frac{Nd}{E_s I_s + E_c I_c}$$

$$M_c = E_c I_c \cdot \frac{Nd}{E_s I_s + E_c I_c}$$

$$f_c = \frac{N}{A_c} \pm \frac{M_c \cdot t/2}{I_c}$$

$$f_s = \frac{N}{A_s} \pm \frac{M_s \cdot C}{I_s}$$

Positive signs in f_c and f_s correspond to concrete and steel stresses in the plane of separation of materials.

Example

Considering the same slab and girder of the former example and assuming that $\epsilon = 1 \times 10^{-4}$ inch per inch, we find in the concrete slab: stress on the top fibre, 17.6 p.s.i.; lower fibre, 81 p.s.i. (both of the same sign). In the steel girder: on the top flange, 2170 p.s.i.; and lower flanges, 655 p.s.i. (both of opposite sign).

4. Effect of thermal expansion difference at low temperatures and concrete growth

In these cases, the stresses as indicated above are reversed and hence decrease existing stresses in sections subjected to positive moments. Thus their effects have to be considered only in the case of continuous bridges in sections above the piers where negative moments are taken by steel girders only.

Assuming that concrete has set at 70°F. and that temperature drops to −40°F. and that its thermal expansion is 3.5×10^{-6} per °F. against 6.5×10^{-6} for steel, $\epsilon = (6.5 - 3.5) \times 10^{-6} \times 110 = 3.3 \times 10^{-4}$ assuming that in the negative moment section the total stresses in the extreme girder fibres reach 20,000 p.s.i., as authorized by specifications.

For a limestone concrete the figure 3.5×10^{-6} is rather conservative since lower figures have been reported. If any possibility of concrete growth exists then buckling of the web may occur due to combination of longitudinal high stresses and

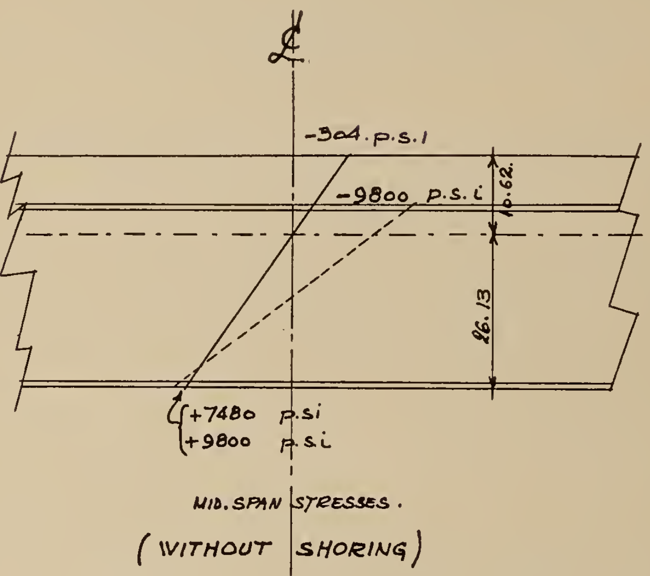


Fig. 5. Dead and live load stresses (span 56 ft. 9 in.; M.15 truck loading).

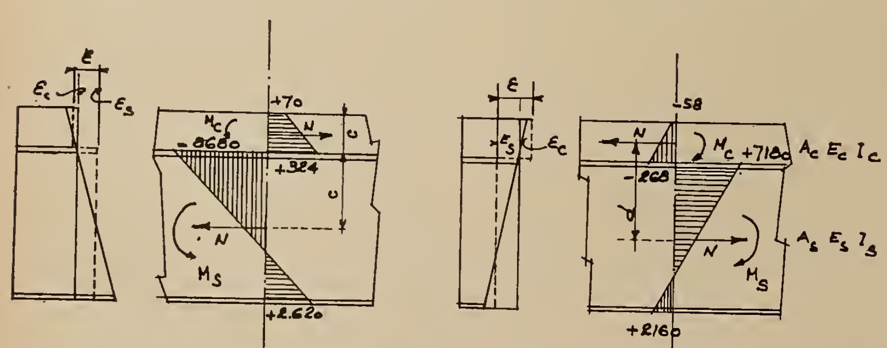


Fig. 6. Shrinkage and thermal stresses. Right: strains and stresses due to shrinkage creep and temperature difference; $\epsilon = 4 \times 10^{-4}$. Right: Strains and stresses due to thermal expansion between concrete (3.5×10^{-6}) and steel (6.5×10^{-6}) between 70°F. and −40°F.

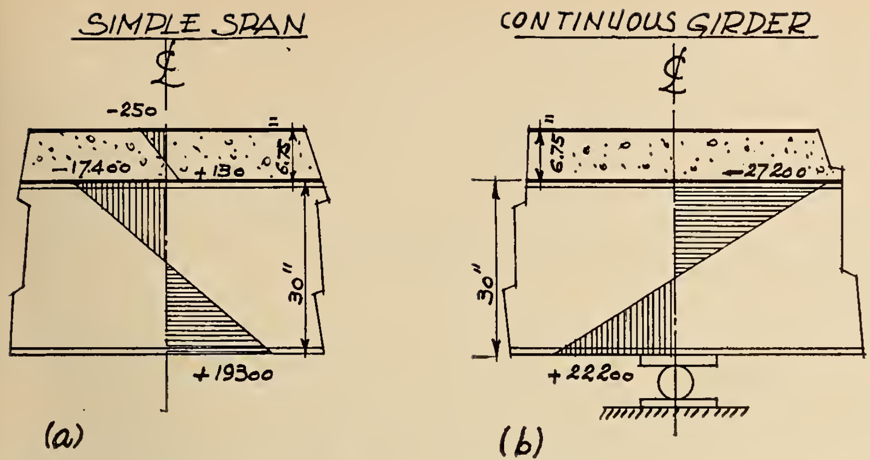


Fig. 7. Total stresses. (a) Stresses due to shrinkage, temperature difference, dead and live load (table). (b) Stresses in section above piers due to thermal expansion difference at —40°F. and dead and live loads (table).

Table II. (Fig. 7a)

Type of Stress	Concrete Slab Top f_1(p.s.i.)	Concrete Slab Bottom f_2(p.s.i.)	Steel Beam Top f_3(p.s.i.)	Steel Beam Bottom f_4(p.s.i.)
Shrinkage (1×10^{-4})	+17.6	+81	−2170	+655
Creep (2×10^{-4})	+35.2	+162	−4340	+1310
Temperature difference (1×10^{-4})	+17.6	+81	−2170	+655
Total	+70.4	+324	−8680	+2620

Without shoring, creep is not considered, thus the total stresses are[3]

Shrinkage and temperature	+ 53	+243	−6510	+ 1965
Live and dead load	−304	−111	−10910	+17280
Total	−251	+132	−17420	+19245

Continuous Steel Girder (Fig.7b)

Type of Stress	Section above Piers: Concrete Slab Top f_1(p.s.i.)	Concrete Slab Bottom f_2(p.s.i.)	Steel beam Top f_3(p.s.i.)	Steel beam Bottom f_4(p.s.i.)
Live and dead load stresses	0	0	+20000	20000
Expansion stresses (3.3×10^{-4})	0	0	+7200	2200
Total	0	0	+27200	22200

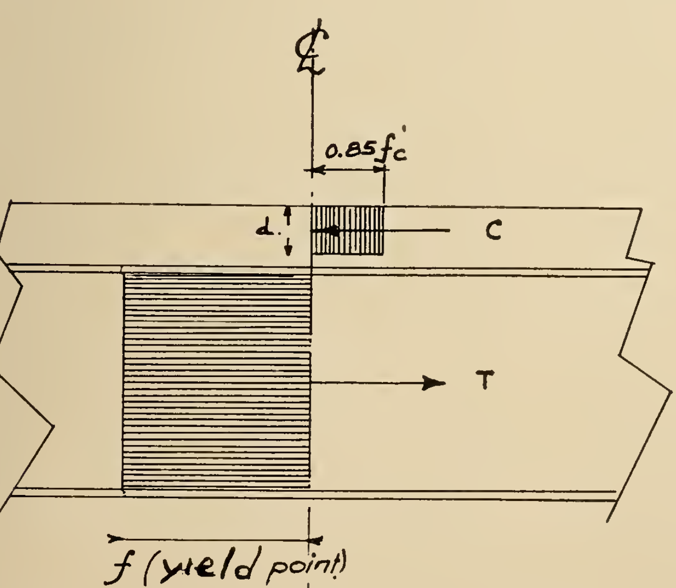


Fig. 8. Ultimate stresses. Distribution of stresses at failure.

shear stresses which are maximum in these sections. No anchorage and discontinuity of the slab above the piers is the best solution to suppress expansion stresses where negative moment exists.

5. Load Factor of Safety (Fig. 8)

Concrete cylinder strength

$f_c = 3000$ p.s.i.

and steel yield point

$f_y = 33000$ p.s.i.

Depth of neutral axis

$d = tA_sf_y/0.85A_cf_c = 5.65$ in.

Plastic moment of resistance

$M_p = A_sf_y(t + c - d/2)$

$= 21300$ kip. in.

Hence total load factor

$= M_y/(M_d + M_l) = 3.2$, and

live load factor $= (M_p - M_d)M_l = 5.2$.

References

1. The Engineering Journal, August 1923, "Steel and slab construction".
2. Ibid., 1931, "Kane system of composite construction".
3. Prof. C. R. Young, University of Toronto. Tables published in C.I.S.C. Handbook, 1937.
4. C. P. Siess, I. M. Viest, N. M. Newmark, University of Illinois, Experimental Station, 1952, Bulletin Series no. 396, "Shear connectors".
5. Prof. K. Kloppel und Weihermuller, **Der Stahlbau**, 1954, vol. 23, p. 121, "Versuche mit Verbundtraegern".
6. D.I.N. 1078, Deutscher Stahlbau Verband (English translation), "Girders for composite construction of road bridges".
7. Highway Research Board, Research Report 14-B (Publication 253, p. 46), 1952, "Load and distribution on highway bridges having adequate transverse diaphragms".
8. I. M. Viest and C. P. Siess, **Public Roads**, 1954, vol. 28, no. 1, p. 9, "Design of channel connectors for composite I beam bridges".
9. Stahlbau-Verlags, Koeln, Heft 5/1954, "Ergebnisse der Versuche und Messungen auf dem Gebiet der Verbundbauweise".
10. D. R. G. Bonnell and F. C. Harper, **J. Inst. Civ. Eng.**, 1950, vol. 33, p. 320, "Thermal expansion of concretes".
11. J. C. Persons, A. C. I., Sep. 1941, vol. 13, "A concrete failure attributed to aggregate of low thermal coefficient"; Sep. 1943, vol. 15, "Supplementary data on the effect of concrete aggregate having low thermal coefficient of expansion".
12. D. W. S. Chow, McGill University Library, 1953, "Thesis on thermal expansion, moisture and creep in concrete".
13. E. G. Swenson and V. Chaly, A. C. I. Journal, 1956, no. 9, vol. 27, p. 987, "Deleterious characteristics of aggregate".
14. Canadian Institute of Steel Construction Handbook.
15. N. M. Newmark, C. P. Siess and R. R. Pennan, University of Illinois, 1946, Bulletin 363, "Studies of slab and beam highway bridges".
16. Same as Ref. 5, and (iv) below.
17. University of Illinois Bulletins: 336-345-363-375-etc.
18. J. Guerin and H. Pigeau, Annales de l'Institut Technique du Bâtiment et des Travaux Publics, Nov. 1950, no. 157, "Ouvrages d'Art à travées continues".

Other References

(i) AASHO, "Standard Specification for Highway Bridges", American Association of State Highway Officials, 1953, Washington, D.C.
(ii) Standard Plans for Highway Bridge Superstructures, U.S. Dept. of Commerce —Bureau of Public Roads, Washington.
(iii) Satler, "Theorie der Verbundkonstruktionen", 1953, Berlin.
(iv) Alpha Composite Construction Handbook, Porete Manufacturing Co., North Arlington, New Jersey, 1953.

The Altitude Test Facility at Orenda Engines Limited

P. K. Peterson

Chief Equipment Engineer, Orenda Engines Limited

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THE REQUIREMENTS of modern interceptor aircraft dictate the continual expansion of the flight envelope of altitude and forward speed that must be met by both the engine and aircraft designer. Greater altitude and forward speed coupled with the constant demand for reduction of specific weight and frontal area require that design engineers must be prepared to introduce, into almost every new engine project, features and principles that are unique and reach to the extreme limit of current research and theory.

Provided the basic design is sound, and the more irrevocable steps that introduce new materials and principles justify the judgement of the designers, it is usual for a period of from three to four years to elapse between the time that the original design leaves the drawing boards and the first production version is built. During this time prototype engines and component parts are subjected to extensive bench testing to reveal weaknesses in the mechanical or performance design and, through constant modification and further testing, the engine is developed to the point that it becomes a marketable product.

The success and prosperity of a company engaged in this highly competitive business depend to a large extent upon the speed with which it can convert the raw design into a mechanically proven unit that meets the performance specifications. The ability of the development organization to carry out this task depends, in turn, upon having the correct tools for the job and, in this case, the 'tools' are the right type, quality and quantity of testing facilities and these must be available at the right time.

The advance of current engines into the rapidly widening range of altitude and forward speed has extended the problems of mechanical design, fuel control, combustion stability, ignition and general performance beyond the limits of acceptable assurance of satisfactory behaviour that have, in the past, been obtained solely from static test beds and flight test aircraft. The need has arisen for a test facility in which an engine, physically static on the ground, may be operated over the wide range of conditions that will be met during service in a modern interceptor aircraft. To meet this challenge several 'engine altitude test facilities' have been designed and are now in service, mainly in the United States.

This paper describes the altitude test facility designed by Orenda Engines Limited for the development of the 'Iroquois' engine. The purpose of such a test facility is to operate an engine, which is physically static on the ground, over the wide range of conditions that will be met during service in a modern interceptor aircraft. The facility provides the correct environmental conditions of pressure and temperature to which the engine would be subjected in flight for all combinations of forward speed and altitude, within a test chamber that contains the engine.

The subject of this paper is the particular engine altitude facility that has been designed by Orenda Engines Limited, for the development of the 'Iroquois' engine.

The subject of this paper involves a very specialized field of engineering. but the paper has been written to provide a general understanding for those to whom the field is strange rather than presenting a complete technical description that would suit specialists. The Orenda facility is designed to test the 'Iroquois' engine. As the size and performance of this engine are classified, all reference to the facility size has been avoided and, where flight envelopes have been shown, it is emphasized that these are typical rather than specific.

BASIC PRINCIPLES AND ARRANGEMENT OF A STANDARD ALTITUDE TEST FACILITY

The essential requirement for testing engines at simulated altitudes whilst they are physically static on the ground is the provision of the correct environmental conditions of pressure and temperature to which the engine would be subjected in flight. The basic function of the facility is therefore to provide these conditions, for any possible combination of forward speed and altitude, within a test chamber that contains the engine. Further, the temperatures and pressures must be held constant throughout any engine transient, e.g. acceleration or deceleration of r.p.m. at a fixed flight condition. The capacity of the facility in terms of the quantity of air is mainly a function of the size of engine to be tested and has no general significance. The capacity in terms of the range of environmental pressures and temperatures is dependent upon the flight operating range and the principles involved in establishing this range should be understood.

Capacity

Figures 1 and 2 show the variation of atmospheric pressure and temperature with altitude. When an engine is moved forward through a static atmosphere, air is compressed in the intake duct and is received by the engine at a pressure and temperature that exceed the ambient conditions of Fig. 1 and 2. The degree of compression is a function of the forward speed and is expressed as the 'ram pressure ratio', this being the ratio of total pressure at the compressor intake to the ambient static pressure. Figure 3 shows the graphical relationship of both ram pressure and ram temperature ratio with forward speed. Forward speed is expressed in the common dimensionless form of Mach No. which is the ratio of the actual forward speed of the engine to sonic velocity in the environment in which it is moving.

To obtain the correct environment for simulating a particular flight condition it is therefore necessary that the following pressures and temperatures in the test chambers be matched with flight conditions:—

(*a*) Engine intake total pressure (P_1)

(*b*) Engine intake total temperature (T_1)

(c) Ambient static pressure (p_1).

(*d*) Ram pressure ratio (P_1/p_1).

Although it is essential that the correct ram pressure ratio be established whilst the gases are discharged from the engine final nozzle at subsonic velocity, some alleviation of the problem occurs once the final nozzle is 'choked' (sonic velocity is achieved) as the engine is then no longer responsive to ram ratio and only to the intake total pressure and temperature. Intake total pressure and temperature (P_1 and T_1) may be derived quite simply from Fig. 1, 2 and 3 for any given flight condition. Figure 4 shows a typical interceptor aircraft flight envelope and Fig. 5 indicates the range

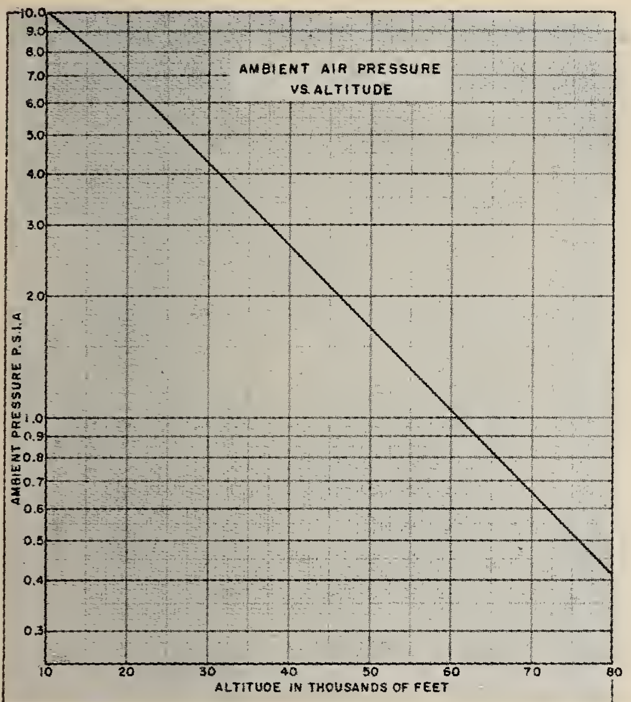


Fig. 1. (left)

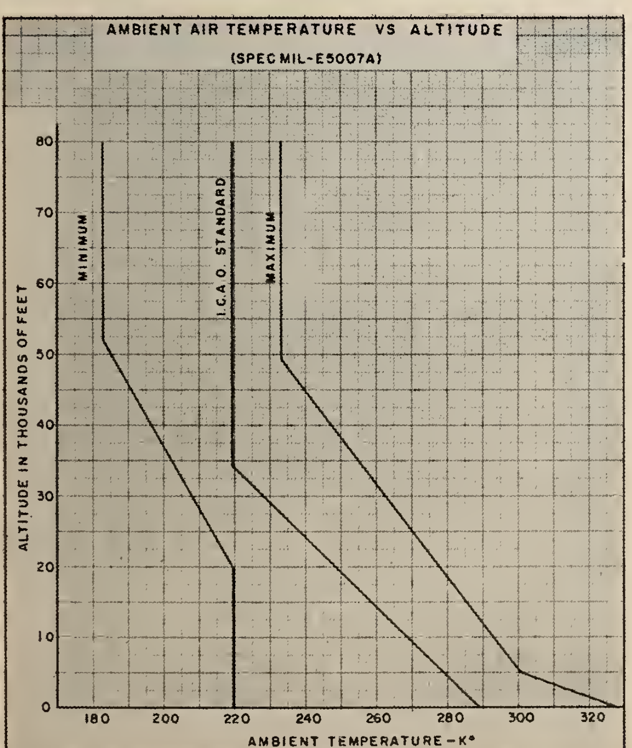


Fig. 2. (Below, l.)

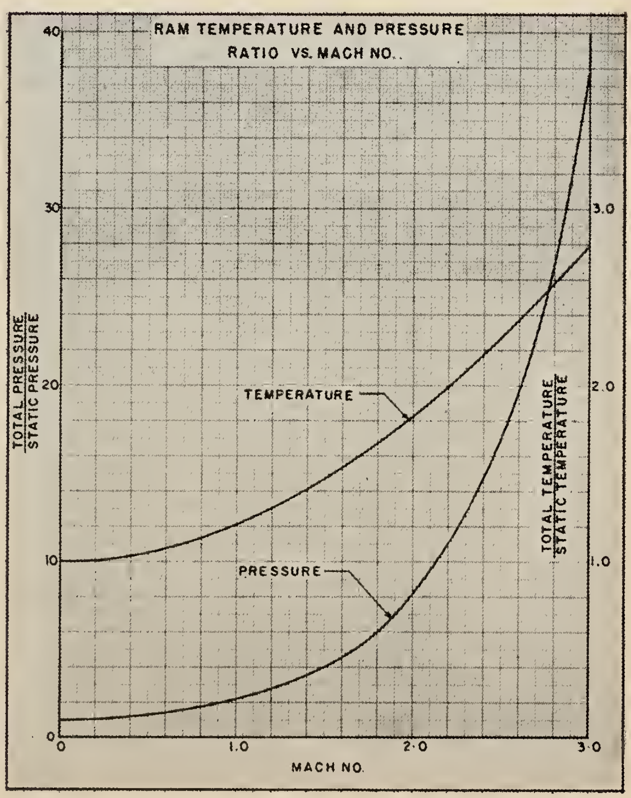


Fig. 3. (below, r.)

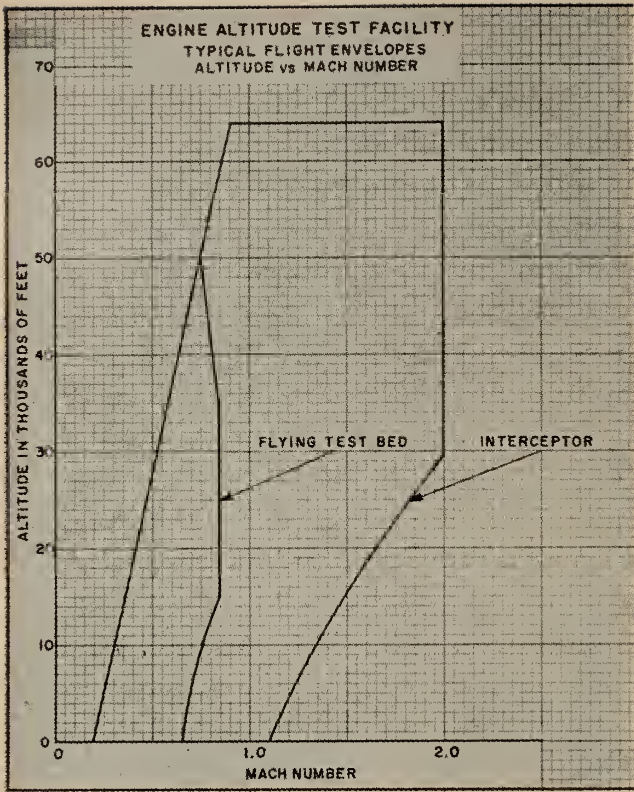


Fig. 4.

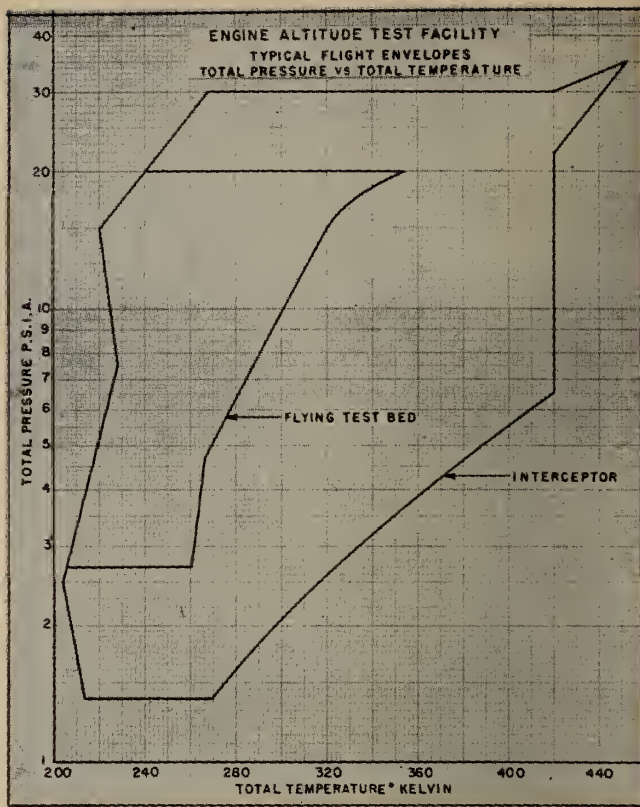


Fig. 5.

of P_1 and T_1 that would be required from a facility designed to meet this envelope. It will be noted that pressures from approximately 1.4 to 35 p.s.i.a. and temperatures from -60 deg. C. to 150 deg. C. are required.

Arrangement of Equipment

It has been stated that the basic function of the facility is the provision and control of the correct environment in the test chamber. This function is performed by various pieces of equipment and plant, operating either independently or jointly, both to condition the air delivered to the engine and create the environment into which the engine discharges. The general arrangement of the equipment may be most clearly understood by reference to the simplified flow diagram of Fig. 6. Air entering the facility may be passed directly to the test chamber to obtain the closest comparison with static test bed operation, or pre-conditioned for both temperature and pressure to simulate the requirements of flight operation. Sub-atmospheric pressures are provided by valve 'A', and pressures above atmospheric by the 'compressor set'. The air may be cooled, within the sub-atmospheric pressure range, by expansion turbines preceded by air drying equipment.

When it is required that the environmental pressure into which the engine discharges be less than 14.7 p.s.i.a., the environment is drawn down to the required pressure level by means of an 'exhauster set'. Some form of gas pre-cooler is essential from consideration of the mechanical aspects of the exhauster pumps and the volume capacity that would otherwise be involved. Any one of the five air intake routes shown on Fig. 6 may be used with the exhauster set, but routes 1 or 4 provide no temperature control and ambient or compressor delivery conditions must be accepted. Controlled pressures and temperatures, either above or below ambient, are available by selection of routes 2, 3 or 5.

The test chamber may be discharged directly to atmosphere for simulating flight at sea-level or when the engine operation is such that the final nozzle is choked and the ram pressure ratio no longer influences performance. With direct atmospheric discharge all but route 3 of the five air intake routes may be usefully selected. Route 3 would not be realistic as the inlet pressure drop, inevitable with the usual methods of cooling directly induced air, would result in a ram pressure ratio of less than unity without the exhauster set in operation.

Although Fig. 6 is entirely diagrammatic it may be employed quite usefully for visualizing the facility as two independent groups of equipment, the first concerned with conditioning the air delivered to the engine, the second with conditioning the environmental pressure into which the exhaust gases are discharged. The two groups of equipment are separated by the test chamber enclosing the engine and some form of diaphragm has to be installed to separate the two environments, intake total and ambient static, to which the engine is subjected. In this way the diaphragm also forms the physical division between the two groups of equipment and is subjected to the full ram pressure ratio applied to the engine.

It is essential that any desired pressure, within the capacity of the facility, be produced exactly, and that the set pressure be held within close limits during any transient condition of the engine or during fluctuations originating in the facility equipment. Engine environmental pressures are established by valve 'A' controlling intake total pressure and valve 'B' controlling the static pressure downstream of the test chamber diaphragm. Valve 'C' controls the inlet pressure to the exhausters and set conditions throughout are closely maintained by the addition of automatic controllers to each of these valves. With direct atmospheric discharge, it is desirable to maintain the pressure at the test chamber outlet as close to 14.7 p.s.i.a. as possible and valve 'C' is not required. The environment pressure downstream of the diaphragm is greater than atmospheric to the extent of the duct losses and these are generally of an acceptably small order.

THE ORENDA FACILITY

The preceding text has dealt solely with general principles and features. Further description must inevitably refer to the variations that are dependent upon such factors as the air pumping capacity, the equipment available, financial limitations, and the designers' or operators' preferences. The remainder of this paper is devoted to a description of the facility at Orenda Engines Limited.

Although designed for testing one of the larger of the current aircraft engines, the Orenda facility is relatively modest in scope and general size, in comparison with some of the eight similar installations known to the writer. Economic necessity has demanded many short cuts and compromises but, throughout the entire design, great care has been taken to provide for extension of the range and increase of the capacity in the future.

Comparing the simplified flow diagram of the Orenda facility (Fig. 7) with the basic flow diagram of Fig. 6, it will be noted that there are two major points of difference. Primarily, the Orenda facility does not have separate plant for pressure and suction air, and it is therefore impossible to pressurize the engine intake and simultaneously evacuate the exhaust. The single installation of motor drive units, gearboxes, and foundations for driven machinery will restrict operation to either intake pressurization or exhaust evacuation at any one time and it will be necessary to interchange compressor with exhauster units as the programme demands. The loss of flight operating range as a result of this limitation and the inconvenience of interchanging the air pumping machinery is not too severe a penalty, however, since this relatively austere arrangement provided the only way the project could be realized without prohibitive costs.

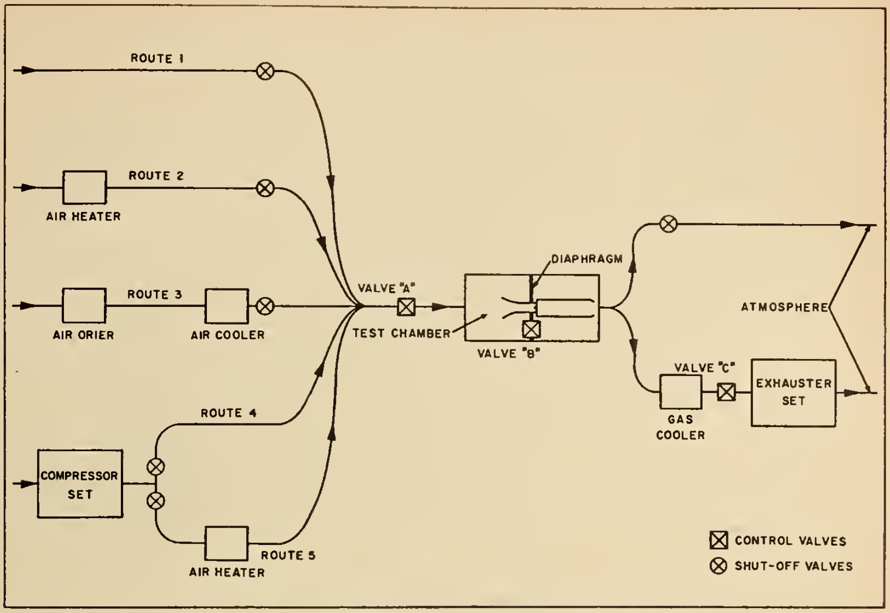
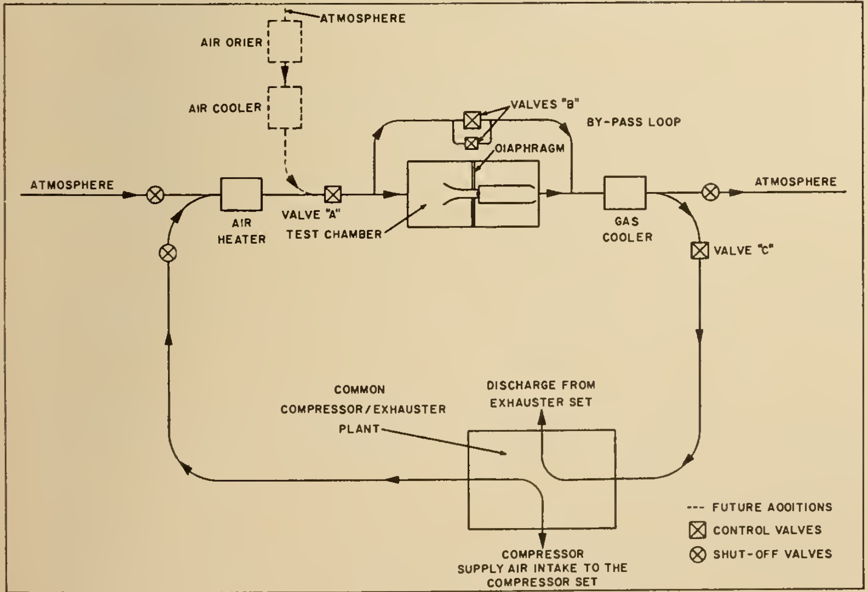


Fig. 6. Simplified flow diagram of basic circuit.

The second major difference is the introduction of a by-pass loop around the test chamber. The loop is essential for a facility that is designed to operate at constant mass flow irrespective of a changing engine demand due to variation of engine rotational speed. A constant mass flow facility was chosen because of the economy of constant speed electric motors and the way in which such a system lends itself to close control of the important parameters that affect engine performance.

When the test chamber is evacuated, air that is surplus to the requirement of the engine is spilled through the by-pass duct to re-enter the system downstream of the test chamber. Valve 'B' transferred from the test chamber diaphragm to the by-pass duct, is changed from a single small valve to two valves of different sizes, placed in parallel, to obtain fine control of the downstream static pressure within the wide range of flows involved. When air is supplied to the engine under pressure, valve 'A' is opened fully and valve 'B' then performs the alternative duty of automatically maintaining the engine intake total pressure constant by acting as a blow-off or spill-control valve.

Fig. 7. Simplified flow diagram of Orenda circuit.



General Arrangement

Figure 8 contains views of the building showing the location of equipment internally and externally. The single-story building occupies an area of approximately 40,000 square feet and is divided into the following six general areas of activity: Compressor room; plant maintenance and boiler room area; office and domestic area; storage and work area; control room; and test cell.

Two major equipment units, the 'air heater' and 'gas cooler', together with sections of the process air ducting are outside the building. The air drying and refrigeration equipment, which are scheduled for later addition to the facility, are not shown but may be located externally if the building is not extended.

Air enters the test chamber either directly from intake No. 1 or indirectly through the compressor set from the dual intakes Nos. 2A and 2B. Exhaust silencer No. 1, in conjunction with intake No. 1, is used for all operations with exhausters and silencer No. 2 is used for all other operations. The air heater, which is located in the common section of ducting leading to the test chamber, is available for heating the air whether it be supplied by the compressors or induced by the exhauster set. The 'compressor room' contains foundations and bed-rails for two strings of compressors or exhausters. Each string, which may consist of a maximum of five units arranged mechanically in series, is driven by a 10,000 h.p. synchronous motor. The two strings, which are entirely independent of one another both mechanically and aerodynamically, draw from, or supply air to, common suction or pressure manifolds connected with the test chamber. The division of the power plant into two independent groups of machinery provides the means of economically testing, within the capacity of a single string, smaller engines in the main test chamber or other test rigs that may be located in adjoining buildings in the future. In addition, the arrangement will permit continued operation at 50 per cent output during a period of maintenance or repair to one of the strings, whenever such operation is feasible.

The test chamber delivers high-temperature gases from the engine into the gas cooler, which is immediately downstream. The gases are cooled to a temperature that is acceptable to the exhauster units by the exchange of heat to circulated water and the cooled gases are then delivered to a large manifold from which separate ducts connect with the two strings of exhauster units in the compressor room. The maximum thermal capacity of the gas cooler corresponds to the maximum heat load under exhauster operation but a greater heat load occurs when air is supplied to the test chamber by the compressor set and the exhaust gases are discharged directly to atmosphere through silencer No. 2. The size and cost of this silencer would be excessive if it were required to handle the volume and temperature of gases in the uncooled state. The gas cooler is therefore used as a pre-cooler and the balance of the heat load is dissipated by direct water injection as damage would otherwise be sustained. Water injection could not be tolerated during operation with the exhauster units because of the increase of volume flow.

For better perception of the general area and features described above, Fig. 9 shows a perspective view of the region of the facility bounded by the ducting leading to the test chamber and the manifold and exhaust silencer downstream of the gas cooler.

Design features of interest are described in more detail in the following section.

Major Features of Interest — Building, Equipment and Services

The single-story building encloses a total volume of 844,300 cubic feet and a floor area of 38,570 square feet. For all structures other than the test cell, which is reinforced concrete throughout, reinforced concrete foundation walls support a steel frame superstructure which carries a 1.5 inch inner sheet and 0.250 inch outer sheet of insulated asbestos siding and pre-cast concrete roof slabs. The compressor room contains a large open pit 7 feet deep, 77 feet long and 63 feet wide that provides headroom for the intercoolers and the runs of ducting connecting the compressor or exhauster machinery and the various manifold ducts drawing from or delivering to the test chamber. Details of this pit are shown on Fig. 8. Permanent internal partition walls are of concrete block and a 120,000 cu. ft./-min. capacity ventilation system, consisting of nine extractor units driven by a total of 38 h.p., is located on the roof of the building to remove the great heat load released by equipment and ducting in the compressor room and test cell. The facility is close to domestic dwellings and offices, and much attention has been given to noise suppression. The walls and roof enclosing the test cell have been designed to provide suitable attenuation and all doors or other openings from noisy areas are suitably treated to prevent the transmission of high noise levels either outside or inside the building. The walls of the compressor room are designed for the later addition of a sound suppression medium should it be found necessary.

Air Heater

The air is heated by direct firing with propane gas as the degree of contamination of the engine air by combustion products is of an acceptably small order.

The heater is a cylindrical vessel approximately 10 ft. dia. by 15 ft. long and weighs approximately 45 tons. Propane gas is injected through burners mounted in the end cover and air enters the main shell radially through a scroll type manifold and passes into the combustion region through holes in an internal liner. Both the body of the vessel and the liner are fabricated from carbon steel. The air outlet temperature is controlled by the rate of gas injection and temperatures are automatically held to within ± 0.5 per cent of any set value by an actuator on the control valve and a control loop which senses air temperature at a point close to the engine intake.

The unit is designed for an air mass flow range of from 20 to 450 lb/sec. A maximum air outlet temperature of 330 deg. C. has been set to meet future applications of the unit.

Test Chamber

The test chamber is formed from three cylindrical sections and one conical section: the latter connects with the inlet ducting from the air heater. Each of the cylindrical sections is 20 ft. long and the screen and conical section are 2 and 15 ft. long, respectively, giving a total length of 77 ft. for the entire vessel. The internal diameter is 12 ft. and the conical section reduces to five ft. six in. to match the diameter of the inlet ducting. The cylindrical walls are one and a half inches thick in the engine section, one inch thick in the remaining two 20-ft. sections and 15/16 in. thick in the conical section. Flanges are 3-in. thick throughout.

When air refrigeration equipment is installed in the future, the chamber will be subjected to temperatures as low as -60 deg. C. and special consideration has therefore been given to the material from which it is constructed. A low (approximately 2.5%) nickel alloy steel (A.S.T.M. Spec. A.203 Grade B) has been selected to give resistance against embrittlement at these temperatures.

The engine is carried by a steel

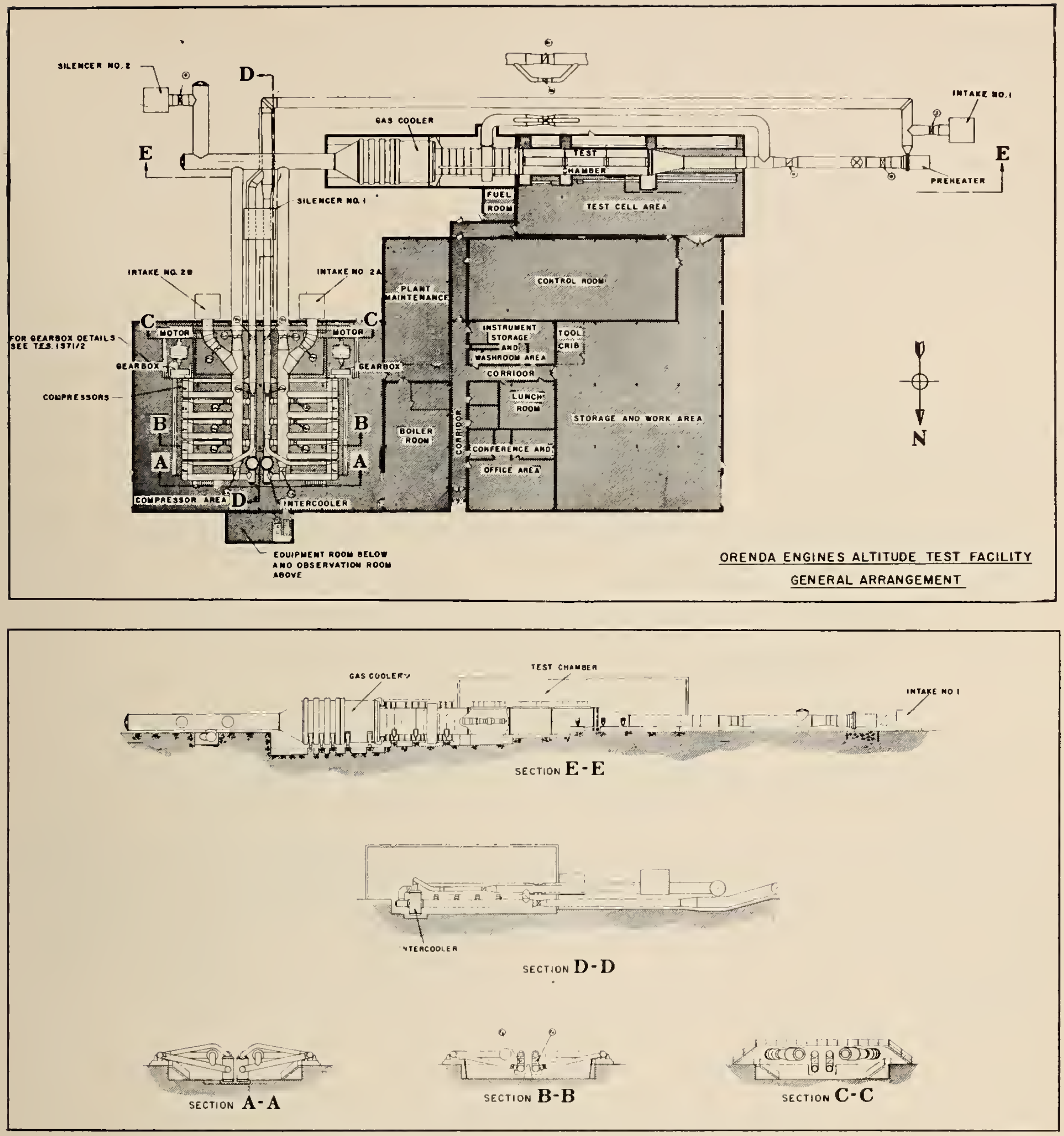


Fig. 8. General arrangement of Orenda Engines altitude test facility

framework attached to the top of the engine section of the chamber through flexible members. These members ensure that there is no restraint in the axial direction other than through the thrust measuring gear that is fitted between the supporting framework and the thrust support anchor. To provide access for installation or removal of the engine, a flange connection may be broken and the entire forward portion of the chamber rolled away from the engine section by means of a power-operated pinion driving a rack attached to the chamber. The displaced portion of the test chamber occupies a space of the test cell that is made available by the prior removal of a suitable length of small diameter upstream ducting. Manholes in the wall of the vessel allow simple adjustments or engine inspection during a test programme, and observation windows are provided for a constant watch of the engine while tests are in progress.

The engine mass flow is measured by instruments placed in a long duct that has a bell mouth opening and is attached to the engine intake. To ensure that the mass flow measurements are accurate and the engine performance is not affected by 'rig' factors, the velocity of the air passing down the test chamber must be uniformly distributed. Two heavy wire mesh screens are fitted across the diameter of the chamber between the conical and cylindrical sections and ahead of the measuring duct, to smooth out any maldistribution of the velocity.

The test chamber diaphragm is of a dished-head form and surrounds the air measurement duct attached to the engine. It is supported at the flange connection, which is split for engine access, and together with the measuring duct remains with the portion of the vessel that is removed. The chamber is supported by twenty cantilevered brackets, each carrying a roller assembly. The rollers are in contact with machined guide rails attached to structural steel beams set in foundation walls raised two feet above floor level. Between the foundation walls a trench, 13 ft. wide and sloping from a depth of 2½ ft. at one end to 6½ ft. at the other, provides clearance for the vessel and suitable drainage. When the test chamber is opened for access to the engine a false floor is introduced to span this trench and facilitate work in the area.

Gas Cooling System

The size of the gas cooler depends on two factors, the maximum heat load to be dissipated without direct water injection and the maximum gas pressure loss that can be tolerated, can be tolerated as the gases are discharged directly to atmosphere through silencer No. 2.

The cooler is divided into the inlet, furnace, cooler and outlet sections, of which the inlet and cooler sections are double-skinned to provide water jackets. The inlet section, which is of the same diameter (12 ft.) as the test chamber to which it is attached, includes an annular manifold through which the by-pass air of the dynamic head (that would otherwise be energy lost in the engine jet stream) and possibly increase the simulated altitude by 15,000 feet at low forward speeds, or increase forward speed from Mach 1.5 to Mach 1.8 at high altitudes.

The furnace and cooler sections are approximately 20 ft. in diameter and reduce, through the conically formed outlet section, to the 90-in. diameter of the downstream manifold.

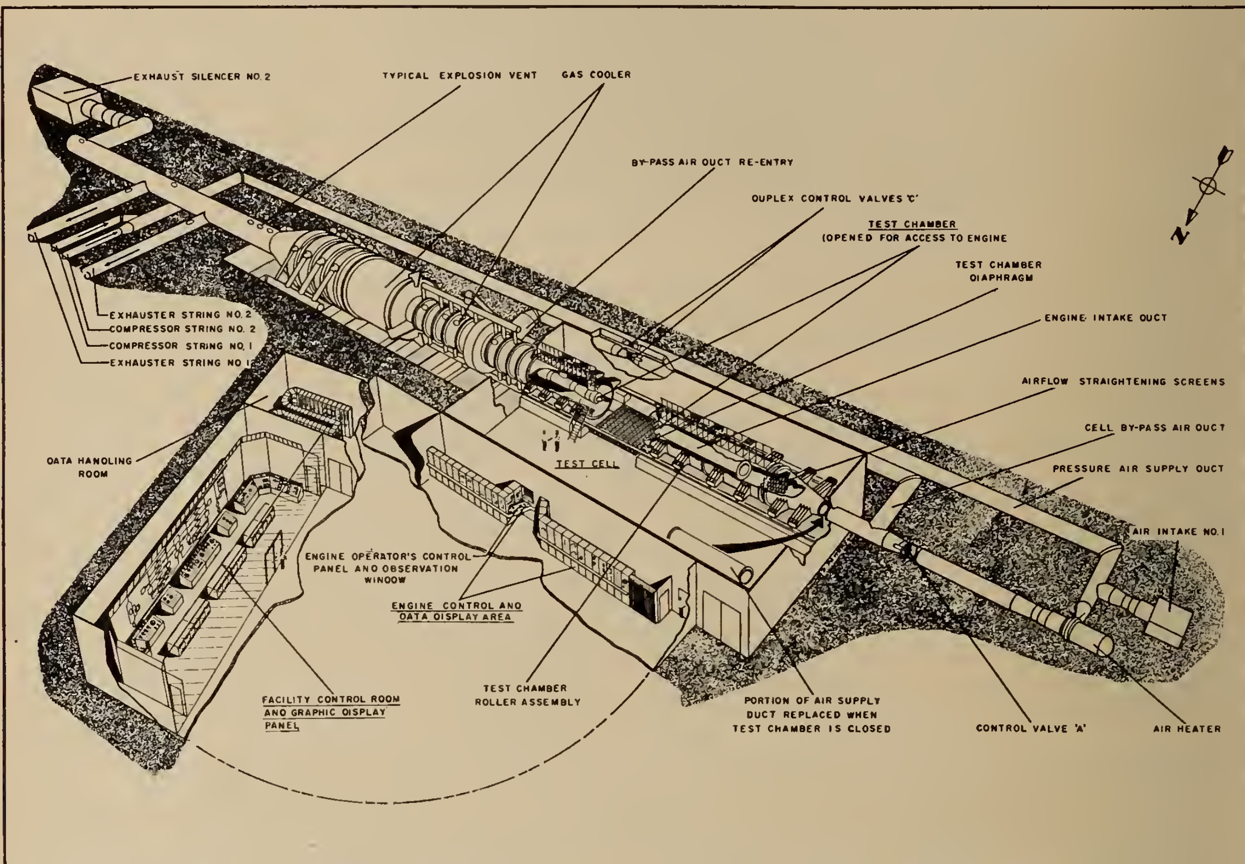


Fig. 9. General arrangement of the Orenda altitude facility, test cell, gas cooler, and control room.

also without water injection. The maximum heat load occurs under conditions of single-stage exhausting and 450 x 10^6 B.t.u./hr. results from cooling 150 lb/sec. of gas from 1770 deg. C. to 65 deg. C. The critical pressure drop occurs during two-stage exhausting and must not exceed 0.12 p.s.i. with a gas throughput of 41 lb/sec. at an inlet pressure of one p.s.i.a., the temperature drop being, as before, from 1770 deg. C. to 65 deg. C. During operations with air blown at the engine by the compressors, the mass flow may reach 450 lb/sec. and the heat load will therefore be tripled. This additional heat load is absorbed by the direct injection of water into the cooler, for in this case the increased pressure drop and gas volume re-enters the circuit. This section of the cooler performs three other important functions. Firstly, as part of the gas cooler design, it provides space for divergence of the engine exhaust jet before it strikes the first row of transverse cooling tubes. Secondly, by virtue of a short conically-formed diaphragm attachment on the test chamber and a flat plate diaphragm attachment on the main body of the gas cooler, it acts as the link in a mechanically flexible coupling unit to absorb possible axial misalignments between these two major units during operation. Thirdly, it provides space for the early inclusion of a conical diffuser at engine outlet. It has been shown by model test that such a diffuser may recover a portion

Two rows of tubes in tangential contact are placed parallel with the cooler axis around the inside wall of the furnace section to remove heat by direct radiation, and four banks of transverse tubing placed across the cooler section downstream of the furnace section remove the remaining heat by convection. Plain steel tubing is used throughout the furnace section, and a mixture of plain and finned steel tubing is used in the first rows in the cooler section. The last bank of tubes in the cooler section is a mixture of copper and copper-aluminum finned tubes.

The total water circulation rate is 11,500 Imp. gal/min. and, with a maximum inlet temperature of 85 deg. F., the water is returned to the reservoir at a maximum temperature of 150 deg. F. When direct water injection is required the consumption is expected to be 1600 Imp. gal/min.

The overall length of the gas cooler is approximately 83 ft. and the weight, under operating conditions, approximately 220 tons.

Reservoir, Cooling Towers and Water Treatment System

Heat is transferred to water circulated through the gas cooler and exhauster intercoolers and from the water to atmosphere in the cooling towers situated above the reservoir. The reservoir is totally enclosed and has a capacity of 660,000 Imp. gallons. The circulated water is treated to prevent deterioration of the heat exchangers and cooling towers and to stop the collection of slime and bacterial growth in the reservoir.

Figure 11 is a schematic diagram showing the entire circulated water system. It will be seen that the make-up water required to replace evaporative losses in the cooling towers is taken from the city water supply and is chemically treated before delivery to the reservoir. Water is drawn from the reservoir and driven through the system by two vertical turbine pumps, each driven by a 450 h.p. squirrel cage motor and delivering approximately 7000 Imp. gal. at a total dynamic head of 170 ft. Operation at extreme conditions for an appreciable period may result in the general level of temperature in the reservoir becoming too high. Rapid cooling of the reservoir water is possible with a by-pass line that circulates directly through the cooler with the facility shut-down.

The cooling towers are formed from three double sections with an induced-draught fan for each of the six single sections so that cooling air entering at the bottom flows in a direction counter to the water entering at the top. California redwood is used in the construction of the towers which have base dimensions of 90 ft. by 60 ft. and are 40 ft. high.

The water treatment system carries out the following basic functions.

(*a*) Provides a slight acidity for protection of the cooling towers.

(*b*) Reduces the calcium and magnesium content to control the deposit of scale on piping and equipment.

(*c*) Deposits a micro-film protective coating on the walls of all metal passages to counteract the corrosive effects resulting from the slight acidity introduced for protection of the cooling towers.

(*d*) Controls the formation of slime and algae in the reservoir.

The acidity is controlled to a pH value of 6.8 (acidic) to 7.0 (neutral) by the introduction of sulphuric acid through the hydrogen cycle cation exchanger. Calcium and magnesium are reduced from 97 and 30 to 0.8 and 0.2 p.p.m. respectively in the duplex unit sodium cycle ion exchanger. The hydrogen and sodium cycles operate on a split stream basis and are designed so that the correct acidity and hardness are achieved when the streams are blended at outlet.

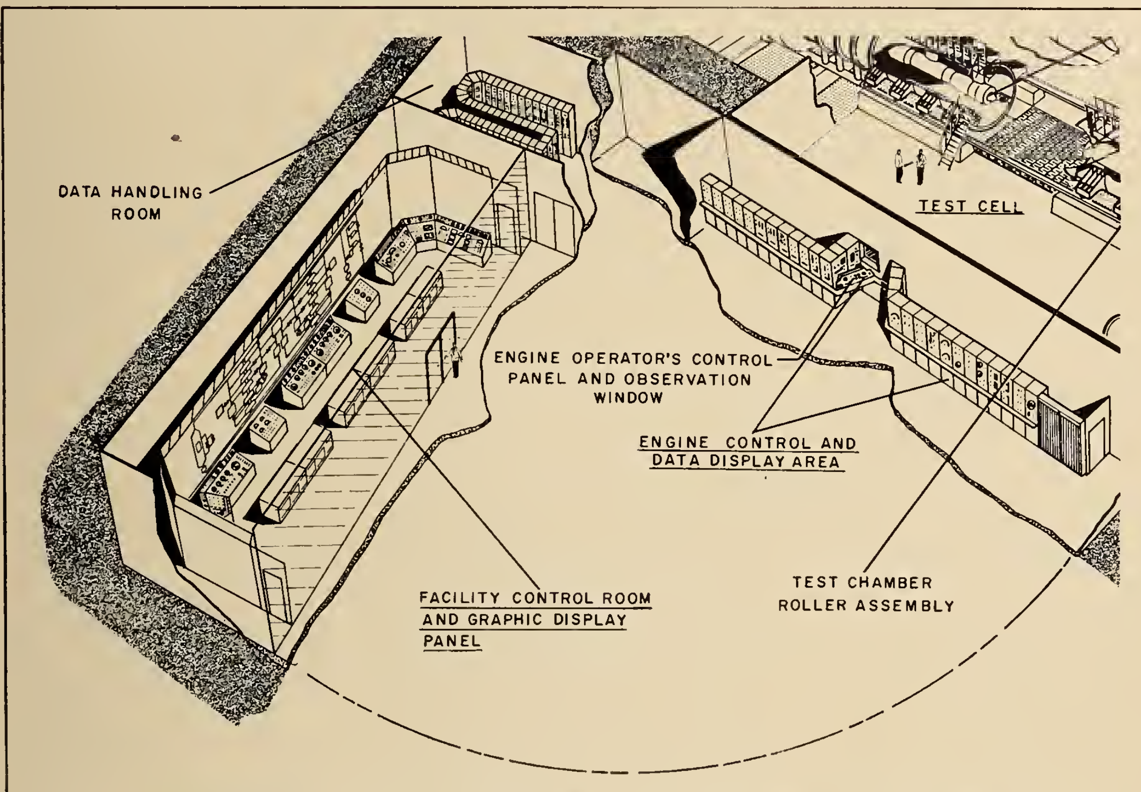


Fig. 10. General arrangement of the Orenda altitude facility control room.

Microfilm corrosion protection for the piping is provided by dosage control of polyphosphate additives introduced into the make-up water line downstream of the hydrogen and sodium cycles.

Slime and algae in the reservoir are prevented by shock treatment injection of metered quantities of chlorine in the make-up water at predetermined intervals.

Compressor/Exhauster Plant

General Description—The axial type compressors that are standard in the Orenda engine were chosen as the basic unit for both the compressors and the exhausters. These units were readily available and it was found that an inexcessive number could quite adequately cover the required range of pressure ratio and mass flow by suitably grouping them in three different configurations, each configuration covering a portion of the total operating range. Further, the compressor and exhauster units are mechanically interchangeable and differ only in the internal blading arrangement. Whereas the blading of the exhausters is identical with that of the engine from which the units are taken, the compressors contain only the first four of the ten rotor and stator blades rows to give a greater mass flow at a sacrifice of pressure ratio.

The range of flight operation is covered by two different arrangements of the exhauster units and one arrangement of the compressor units. For extreme altitudes where minimum exhaust environment pressures are required, two stage exhausting is employed to give a total pressure ratio of approximately 18:1 across the set. In this arrangement ten exhauster units are suitably ducted so that the first four in each string are aerodynamically in parallel and the fifth is in series with an intercooler between the series stages to reduce the temperature and volume of the gases. For medium altitudes, the last two units of each string are mechanically disconnected to give the larger mass flows that are required by the engine and may be derived from a single stage of three units per string with a pressure ratio of approximately 4.5:1. Thirdly, the low altitude portion of the flight envelope is obtained by replacing the exhauster units with two, aerodynamically parallel, compressor type units in each string to provide still greater quantities of air ducted to the engine intake at pressures above atmospheric.

Electric Motor Drives

The ideal form of drive would supply variable torque at any speed from zero to 7200 r.p.m. and any selected speed would have to be regulated within ± 0.5 per cent. This would probably require induction motors and a variable frequency supply would have to be obtained from alternators driven by variable regulated speed direct current motors. D.C. supply would in turn demand motor-generator sets. The constant mass flow system obviates the need for such an expensive arrangement and a constant speed drive with synchronous motors has been chosen as the most simple and economical. The supply frequency is maintained within ± 0.25 per cent so that no speed regulation is necessary. The two 10,000 h.p. motors are supplied from a common 4160 volt bus which is fed by two 10,000 kva. outdoor transformers which step-down the supply voltage from 27.6 kv. to 4160 volts. Disconnect switches enable either of the transformers to be used separately to supply part load to both drives, or to supply either drive at full load. Provision has been made for forced air cooling of the transformers and this would increase their rating to 13,333 kva. The load break switch shown on Fig. 12 will normally be open so that the 550 volt supply to the facility will be affected as little as possible by load variations on the 4160 volt bus.

Each motor must be started separately and at reduced voltage to meet the Ontario H.E.P.C. requirement that the voltage drop at the 4160 volt bus shall not exceed five per cent. Control and protection of the motors is provided by Magneblast circuit breakers with an interrupting rating of 250 Mva. The starting sequence is automatic. On pushing the 'start' button of, say, motor 'A', No. 1 start breaker closes connecting the motor through current limiting reactors. After six seconds, No. 2 start breaker closes and No. 1 opens, so that the motor then is connected through part of the reactors. After a further five seconds the 'run' breaker closes and No. 2 opens, connecting the motor at full voltage. The periods are selected to allow sufficient time for the H.E.P.C. tap changing mechanism at the distribution centre to increase the supply voltage. When the motor has reached approximately 97 per cent full speed, the d.c. excitation is applied automatically. Two separate 60 volt d.c. motor-generator sets provide excitation of the rotors and overvoltage can be supplied for a period of one minute. If motor 'A' is running under load when motor 'B' is starting, the field of 'A' can be forced to counteract the tendency to pull out of synchronism as a result of the drop in supply voltage.

The two 10,000 h.p. motors rotate at synchronous speeds of 1200 r.p.m., have a power factor of 1.0, and are supplied with 3-phase 60-cycle current at 4160 volts. The locked rotor torque is approximately 50 per cent and the pull-out torque is 150 per cent with normal line reactance. Control circuits include protection against overcurrent, undervoltage, automatic reclosure of breakers, circulating currents, overheating, and incomplete starting sequence.

Gearboxes

A single-ratio speed-increasing gear unit is used in each string of compressor/exhauster units to step-up the synchronous speed of the 10,000 h.p. electric motors from 1200 r.p.m. to 7223 r.p.m., the design point speed of the driven machinery.

Double helical involute form spur gear teeth are used and the pinion is cut from a solid high-grade steel forging that is integral with the shaft. The low speed gear is fabricated from a carbon steel rim shrunk on a carbon steel hub and the teeth are cut with full face contact.

The casing is split at the centreline of the gears, and supports steel-backed, babbit-filled, horizontally-split sleeve bearings that may be removed without disturbing the gears. The force-feed lubrication system is self-contained within the gear unit and the oil is cooled by water in an external tubular type heat exchanger.

Intercoolers

The function of the intercooler is to reduce the temperature and volume of the air, that has been compressed in the first stage exhausters, to conditions that are acceptable to the second stage. An identical unit is installed in each of the two independent strings of machinery located in the compressor room.

The main shell of each unit is a cylinder 5.5 ft. in diameter and 8 ft. long mounted with the axis of the cylinder vertical. Double-pass banks of finned tubing are supported from the top of the shell and sealed at the bottom with a floating diaphragm. Dished heads are used to close each end of the vessel, and the upper head is divided to serve as a combined inlet and outlet manifold for the water circulated through the double-pass banks of tubes.

Air flows across the tube coils, at right angles to the cooler axis, between inlet and outlet headers attached to the walls of the vessel. The first six rows of finned tubing are copper and the remaining fourteen are aluminum with copper lining.

Each cooler is designed to dissipate 12.7×10^6 B.t.u./hr. using approximately 400 Imp. gal/min. of treated water entering at 85 deg. F. The maximum airflow capacity will be 41 lb/sec. at 7.8 p.s.i.a. and the air will be cooled from 265 deg. C. to 65 deg. C. The air pressure drop is a maxi-

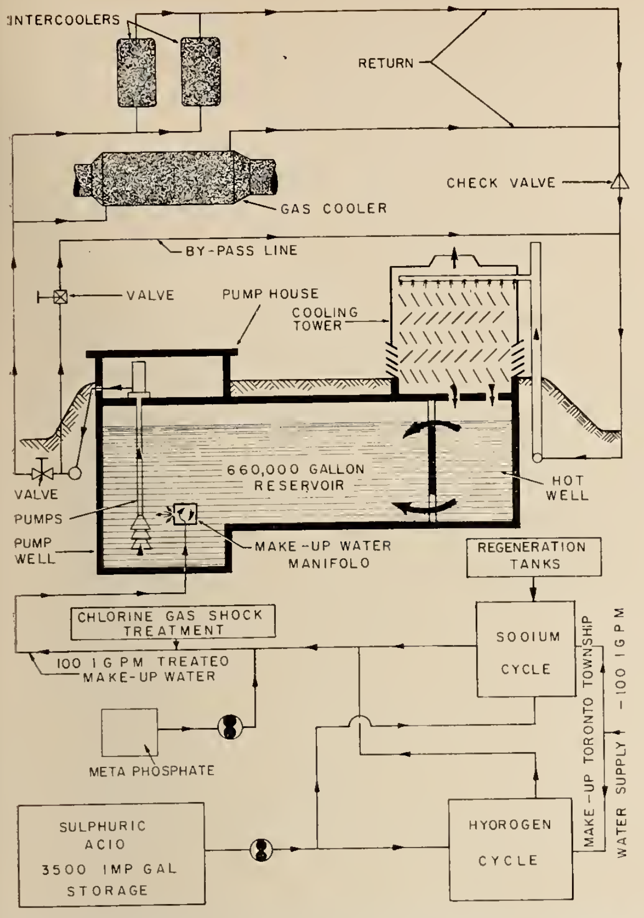


Fig. 11. Schematic of the circulation through water cooling and water treatment system in the Orenda altitude facility.

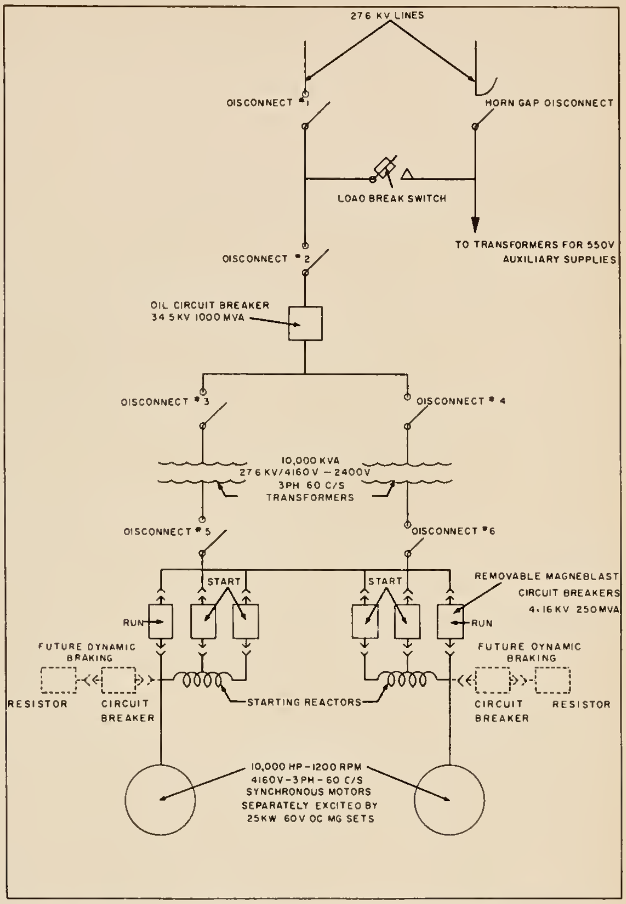


Fig. 12. One line diagram of electric power supplies to 10,000 h.p. motors in Orenda altitude test facility.

mum of 0.18 p.s.i. at 21 lb/sec. throughput and 3.7 p.s.i.a. inlet pressure.

Mechanical Installation of the Compressor/Exhauster Units

To protect the compressor or exhauster set from a two-phase to ground short of the driving motors, a shear coupling between each motor and gearbox is designed to fail at a torque that will be 50 per cent greater than that which will result from the emergency use of aerodynamic braking. Aerodynamic braking can be applied by the rapid operation of control valves to increase the air load, and a reduction from 7000 to 1000 r.p.m. in three seconds is possible.

The driven units of each string are mounted from two pairs of 45-ft. long structural steel bedrails, machined on the top surface to carry support plates, and set in a continuous, reinforced concrete foundation. Two pairs of support legs are mounted on the bedrails for each unit and carry, through trunnions, two heavy cast rings within which the unit is is supported by means of six tangenial links at the fore and aft planes. Two axial links on the forward ring take the small axial thrust. All links are adjustable and provide for the maintenance of concentric alignment of the units within the rings, as set up under assembly shop conditions, irrespective of thermal expansions during operation. Axial and transverse forces resulting from air pressure and ducting loads are transferred through trunnion brackets on the support rings to the support legs and foundation rails.

The driving torque is transmitted from the gearbox to the first unit, and between each of two succeeding units of the string, through a short shaft with a toothed coupling at each end to provide the required flexibility at each connection.

A perspective view of the mounting arrangement described above is shown on Fig. 13.

Control System

The control system is required to carry out the following functions:

(*a*) Control of inlet pressure and temperature to the test chamber.

(*b*) Control of static pressure at outlet from the test chamber.

(*c*) Maintenance of constant mass flow for any given simulated flight setting of the facility.

(*d*) Prevention of 'surge' either of the compressors or exhauster units.

(*e*) Programme control for starting and shutting-down the compressor/exhauster plant.

(*f*) Aerodynamic braking of the compressor/exhauster plant.

Items (*a*) and (*b*) concern the engine environment and (*c*), (*d*) and (*e*) are directly associated with control of the compressor/exhauster plant. These two systems are described separately below.

Engine Environment Control System—Three valves are used to control the engine environment. The function of valves 'A' and 'B' (Fig. 7) have been described previously but to recapitulate briefly, valve 'A' governs the total pressure delivered to the test chamber and valve 'B', located in the by-pass duct, controls the static pressure into which the engine discharges. When air is supplied to the engine at pressures greater than atmospheric, valve 'A' is fully opened and valve 'B' then governs the inlet pressure by controlling the amount of air spilled through the by-pass. Inlet temperature to the test chamber is controlled by the third valve which governs the rate of injection of propane gas into the air heater.

Better appreciation of the pressure control system may be gained by considering the action of the two valves during an engine acceleration from half to full speed at any given simulated flight condition of altitude and forward speed. The period involved may be two to three seconds, and the environmental conditions at the engine intake and exhaust will have been established at the start of the acceleration. It is the function of the control system to maintain these conditions as closely as possible as the engine accelerates. The engine air consumption increases as the fuel control throttle is opened, but with a constant facility mass flow system the total flow through valve 'A' will remain approximately constant whilst the proportion of the total flow that is by-passed through valve 'B' will decrease progressively. Small changes of the engine upstream total pressure due to the transient operation will be sensed and compensated by rapid automatic action of valve 'A'. As a result of the reduction of by-pass airflow and the maintenance of a constant upstream total pressure, the static pressure downstream of valve 'B' will increase if the valve position remains unchanged. Valve 'B' responds to the downstream static pressure and restoration of the preset value of this pressure and, in consequence, the ram pressure ratio across the engine, is accomplished by progressive closing of the valve.

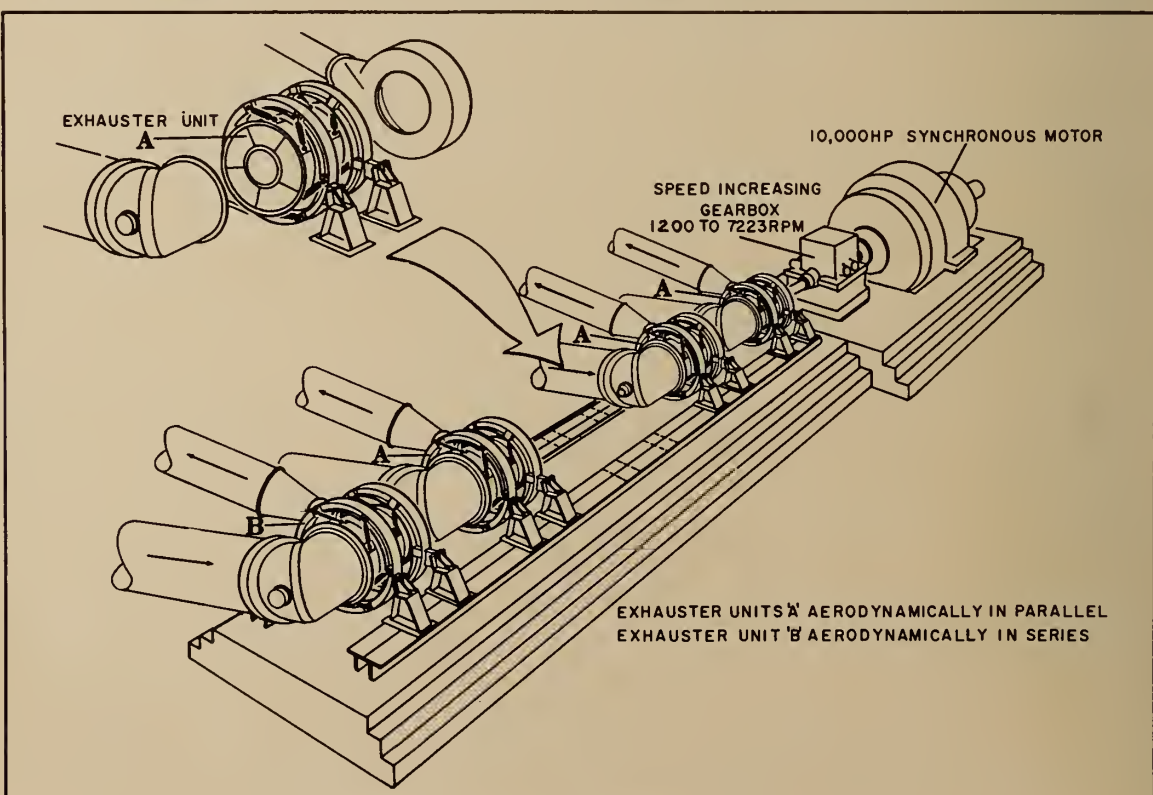
The initial installation will permit the study of performance during engine transient conditions but not during flight-transients (trajectories) of forward speed and altitude. The design does, however, provide for this extension of scope in the future.

Compressor/Exhauster Set Control System—Figure 14 is a schematic diagram of the compressor/exhauster plant showing the location of control and configuration valves in the ductwork connecting the units.

The air mass flow induced by the exhausters, when operating at a fixed rotational speed and discharging to atmosphere, is dependent upon the temperature and pressure of the air at intake. The inlet temperature is held constant by the gas cooler and small variations have little effect. The inlet pressure is controlled automatically to a preset value by valves 'C', and this control therefore holds the air mass flow constant for the selected operating condition.

The Ontario H.E.P.C. requirements for voltage regulation make it necessary that the two 10,000 h.p. motors be started at reduced voltage, and the incoming current limiting reactors are cut out in two steps. To prevent burning out the starting windings it is essential that the motors reach synchronous speed as rapidly as possible. To resolve these two conflicting demands, the aerodynamic load imposed by the exhausters during the start-up phase is kept as low as possible. To obtain minimum start-up loads the pressure ratio of both the first and second stages of exhausters is controlled according to a preset programme in terms of rotational speed. The characteristics of the exhauster units are such that minimum load is achieved with maximum pressure ratio and it is therefore desirable to hold the operation as close to the surge line as possible. Maximum pressure ratio is achieved with minimum inlet pressure and during start-up with either single-stage or two-stage exhausters valves 'C' are kept closed. During single-stage exhausting (three units in parallel) valves 'M' are programmed to open just sufficiently to keep the units out of surge as they accelerate. With two-stage exhausting, valves 'L' and 'F' are programmed to allow a controlled proportion of the flow

Fig. 13. Arrangement of one string of exhausters and driving equipment in the Orenda altitude facility.



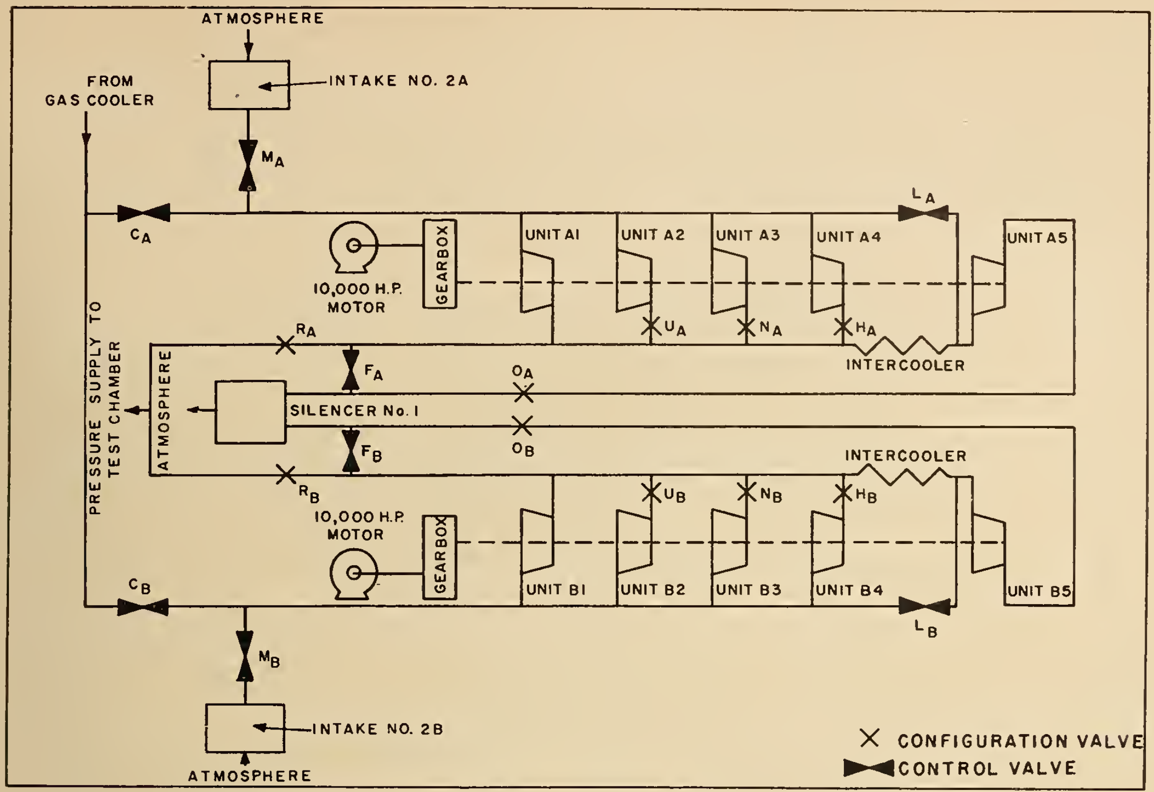


Fig. 14. Compressor/exhauster set control system, schematic diagram.

to be recirculated through the first and second stages respectively and maintain, as before, operation close to surge.

Throughout the start-up phase the programme control cannot take effect until the volume upstream of the compressors has been drawn down to the correct pressure level by the exhauster units. The duct lengths have been kept to the minimum to enable the volume to be evacuated as rapidly as possible. The programmed control used during this start-up procedure is applied when the motors are shut-off to maintain similar operation, in relation to the surge line, during the run-down.

During steady running, it is possible that, for some reason such as mishandling of the facility, the compressor or exhauster units may go into surge and create a condition that could cause considerable damage to the units and associated equipment. The first stage of exhausters is protected by the automatic opening of valves 'M' to increase mass flow and bring the operating point away from surge when a pre-set limiting pressure ratio is reached. Valves 'C' are locked open to counteract the automatic tendency to close and re-establish the lower intake pressure. The second stage exhausters are protected by valves 'F' which open automatically to recirculate when a limiting pressure ratio is reached.

Rapid deceleration of the set is possible by increasing the aerodynamic loading either by increasing the inlet density or increasing the pressure ratio across the set. During exhauster operation, the load is increased by programmed opening of valves 'M' to increase the inlet density. The compressors draw from atmosphere and as the inlet density cannot be increased in this case, the load can only be increased by outlet throttling through valve 'A'. The tendency to surge during the rapid deceleration is counteracted by valves 'L' that are operated on a programmed basis to recirculate controlled quantities of air through the compressors and intercoolers. Any one of four different rates of deceleration may be selected for emergency use either with compressors or exhausters installed.

Butterfly valves are used throughout the entire control system including valves 'A' and 'B' in the test chamber area. All valves other than the two valves 'B' are tight shut-off and neoprene seats are used wherever temperatures are less than 100 deg. C.; for greater temperatures piston ring seals are used. The valves are operated by hydraulic actuators through electro-hydraulic servo-valves integral with the main valve and supplied with hydraulic oil at 3000 p.s.i. through a check valve and accumulator. One 30 h.p. (15 g.p.m.) hydraulic pumping unit serves each exhauster string and valves 'A' and 'B' are served by 10 and 20 h.p. units respectively.

Control Room

The control room is shown in perspective view in Fig. 9 and 10. From this room, which is virtually the nerve centre of the entire facility, signals are transmitted and received to govern and report the state both of the process air system and the test engine as follows.

1. (*a*) Control of the process air system and equipment.
   (*b*) Monitoring of signals received from the process air system and equipment.
2. (*a*) Control of the test engine.
   (*b*) Monitoring signals from the test engine.
3. Handling and recording of data originating at the test engine.

It is essential that there be close co-operation between the groups of operators responsible for the three

(Continued on page 64)

Spouting of Large Particles

C. B. Cowan, W. S. Peterson, and G. L. Osberg

Division of Applied Chemistry, National Research Council

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The recently discovered method of gas-solid contact called "spouting" are reviewed and compared with firmly established operations such as fluidized and moving packed beds. Experimental data obtained from the drying of wood chips are used to illustrate one of its potential applications to large particle sizes.

THE SPOUTING bed method of contacting gas and granular solids has recently been described by Mathur and Gishler.[4] This is a new development which has potential application to the drying or chemical treatment of large particles which normally fluidize poorly, if at all. This paper will review the properties of a spouted bed, compare them with similar properties of the closely related fluidized bed. The results of experiments with the spouting of cellulose acetate and wood chips will then be presented.

Fluidized and Spouted Beds

The fluidized bed is a gas-solid method of contacting which is very extensively used in chemical reactors employed in the petroleum refining, chemical processing, and metallurgical industry. It is obtained by passing a fluid up through a bed of powder at a velocity which suspends part of the bed on the fluid stream. Turbulent mixing of the powder and fluid will then occur. Diagram A in Figure 1 illustrates diagrammatically a fluidized bed. Here a bed of fine powder is depicted as undergoing a motion within a vessel as a result of gas flowing up through its porous bottom. Such a bed provides excellent gas-solid contact, and hence is efficient for chemical reactions involving such heterogeneous systems. Its pseudo-fluid behaviour makes the addition and withdrawal of powder from the vessel quite easy. Particle sizes used in fluidization are usually in the range 60 to 325 Tyler mesh, though particle sizes up to ¼ inch have been reported.

Larger particle sizes than ⅛ inch, however, exhibit poor fluidizing behavior. Such coarse particles tend to slug, a condition caused by the formation of excessively large bubbles within the bed. This slugging results in poor mixing within the bed and less uniformity in the properties of the bed.

It was the "slugging" behaviour which Mathur and Gishler [4,5] encountered when trying to fluidize wheat in a 6-inch diameter column, and which they avoided by modifying the air inlet so as to produce a well-defined air lift core up the centre of the bed. The particles carried up the core appeared at the top as a fountain, then fell back on to the bed, moving down the annulus as a loosely packed bed. The bed particles thus go up the spout and down the annulus, migrating as they descend back into the spout. Particle motion within the annulus is streamline and without lateral mixing; in this respect it is unlike the fluidized bed, where more random motion of the bed particles leads to lateral as well as longitudinal mixing. Diagram B, in Figure 1, illustrates a spouted bed. Diagram C illustrates a conventional moving packed bed[9] which is similar in many respects to the annulus section of the spouted bed. In all cases addition and continuous withdrawal of bed particles can be arranged.

Pressure Drop-Flow Relationship

The pressure drop versus flow relationship is illustrated in Figure 2. Curve A is a generalized plot for a fluidized bed, and curve B for a spouted bed. The initial section 1-2 of curve A is typical for a packed bed and can be predicted from a modified Carman-Kozeny equation for fixed beds. At 2 the pressure drop across the bed deviates from linearity and corresponds to the beginning of expansion of the bed. At 3 fluidization begins, and at 4 the whole bed is fully fluidized. As the flow is increased motion becomes more violent, but pressure drop remains constant and is equal to the weight of the suspended bed.

In curve B, the section 1-2 corresponds to a flow through a packed bed. At 2 there is sharp expansion in the bed as an internal spout forms at the inlet. The internal spout increases in size, and at 3 breaks through the top of the bed. This point is defined as incipient spouting. Further increases in flow cause a slight drop in pressure to 4. The pressure drop for a spouted bed is lower than it would be for a fluidized bed of the same height simply because part of the air flow by-passes through a large hole in the bed. With wheat, for example, about 60 per cent of air flow is through the annulus, and 40 per cent through the core. On reducing the air flow the pressure relationship follows 3′-1. At 3′ the spout has collapsed

Section 1′-2′ is the relationship for a loosely packed bed. The difference in Δp vs. G relationship between fluidized and spouted bed is due to the formation of the spout and, as the bed height reaches the maximum spoutable height, the two curves become much alike.

Minimum Spouting Velocity

The conditions of inlet air diameter, air flow rate, bed depth, and particle size necessary for spouting are critical. For a particular particle size and column diameter, there is a maximum inlet air size beyond which spouting does not occur. The maximum bed depth to which a certain material can be made to spout is also limited and depends on the column diameter and inlet air size.

The minimum amount of air required to cause spouting has been determined under a variety of conditions by Mathur and Gishler and by Thorley et al.[4 8] Particle sizes ranging from 0.025 to 0.25 inch have been spouted in 6, 12, and 24 inch diameter columns. Materials such as wheat, rice, gravel, peas, etc. have been spouted in air and water. They have proposed the following correlation:

$$V_s = \left(\frac{d_p}{d_c}\right)\left(\frac{d_i}{d_c}\right)^n \left(\frac{2gL(\rho_s - \rho_f)}{\rho_f}\right)^{1/2} \quad (1)$$

where n = 0.23 for a 45° cone
= 0.13 for a 85° cone
V_s = min. flow required for spouting
d_p = diameter of particle
d_c = diameter of column
d_i = diameter of inlet orifice
L = depth of bed
ρ_s = absolute density of solid
ρ_f = density of fluid

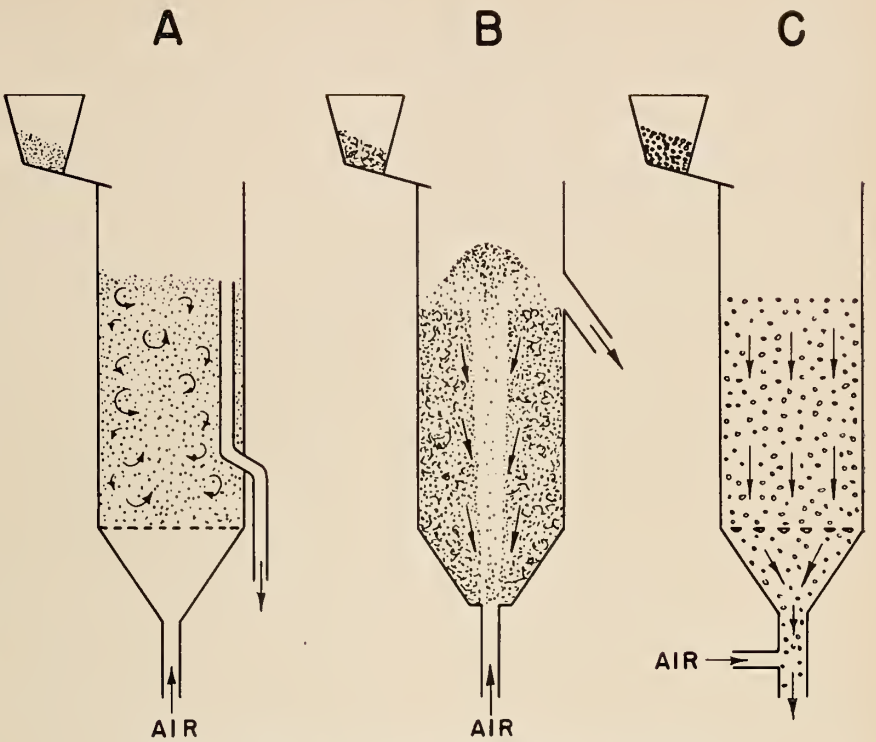


Fig. 1. Diagrammatic fluidized, spouting, and moving beds.

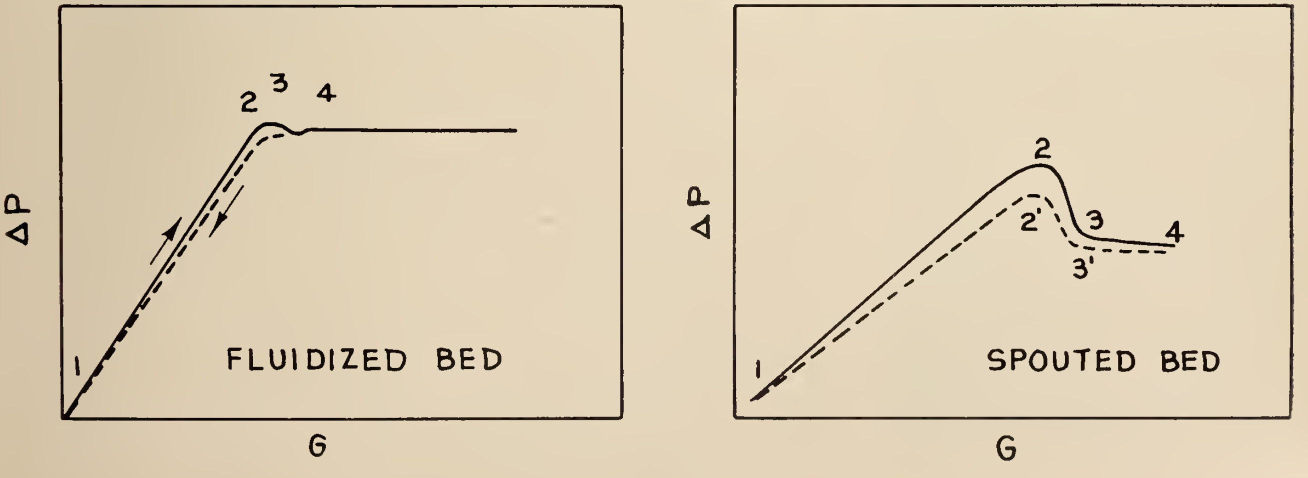
From this formula an estimate of the minimum gas velocity required for spouting can be made for materials whose properties are within the range of the variables on which the correlation is based. In practice, a gas velocity about 10 per cent larger than calculated should yield satisfactory spouting.

Heat and Mass Transfer

In the particle size range 40 mesh to ⅛ inch, a bed of powder can be fluidized or spouted although, as noted earlier, fluidization will be poor. Nevertheless, a useful comparison of such properties as heat transfer and mass transfer can be made between the two modes of bed agitation.

In the case of heat transfer between a bed and a heated wall, the heat transfer coefficients are substantially higher for a fluidized bed than for a spouted bed. In Figure 3, some comparative data by Klassen and Gishler[2] are given. For a fluidized bed of Ottawa sand (20-30 mesh), the maximum value was about 40 Btu/hr/sq. ft./°F. as compared with a maximum of about 10 Btu/hr/sq. ft./°F. for a spouted bed of the same sand. Similar data are given for wheat

Fig 2. Pressure drop (ΔP) *v.* mass flow (G) relationship for fluidized and spouted bed.



and rice. The higher heat transfer values for fluidized beds are probably due to the higher particle velocities and greater particle mixing at the wall.

Comparative data on mass transfer rates are limited. Preliminary data[6] for a liquid-solid system in which limestone particles were contacted with very dilute hydrochloric acid show that the mass transfer rates were slightly less in the spouted bed than in either the fluidized or fixed bed. This decrease is probably due to the fact that the fluid passing through the spout by-passed the bed. Thus, these heat and mass transfer data show that where a bed material will fluidize satisfactorily, there appears to be no advantage in spouting over fluidizing.

Spouting of Cellulose Acetate

The main application for spouting is, however, in the upper range of particle size where fluidizing is unsatisfactory. For example, large particles of cellulose acetate or wood chips cannot be fluidized, but can be agitated satisfactorily by the spouted bed technique. Preliminary experiments have been made with these materials with the object of developing a spouted bed type dryer. The results obtained illustrate some of the limitations as well as the possibilities in the method.

The cellulose acetate consisted of matted fibrous particles in sizes up to one inch in the largest dimension. The particle size distribution is given in Figure 5. The material as received was damp, but since it was proposed to dry it to 30% moisture (on a dry basis), it was air dried to this level of moisture in order to carry out exploratory experiments on its spouting behaviour.

The column used in these experiments was a 2-ft. dia. semi-circular column, fitted with a plexiglass front so that spouting behaviour could be observed. Figure 4 shows the unit containing cellulose acetate.

It was found that, when suitable orifice size had been selected, this

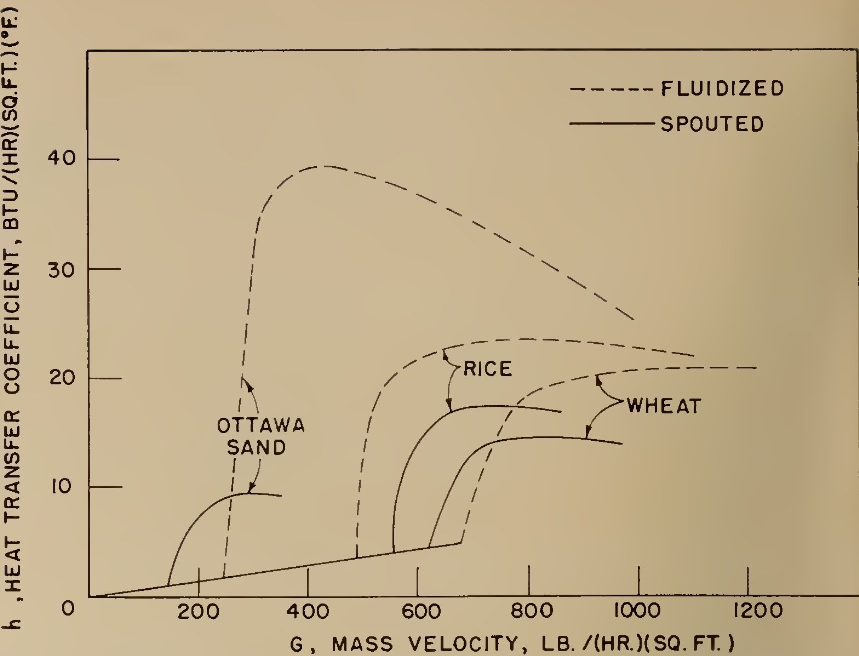


Fig. 3. Comparison of wall to bed heat transfer in spouted and fluidized beds.

Fig. 4. Two-foot diameter semicircular column used in spouting studies.

Table I. Air Requirements for the Spouting of Cellulose Acetate

Orifice Diameter in.	Bed Height ft.	Min. Air Flow s.c.f.m.	Superficial Velocity ft./sec.	Pressure Below Orifice in. H_2O	Pressure Above Bed in. H_2O	ΔP Bed in. H_2O
2	3.0	120	1.3	13.0	0.1	3.2
	5.0	161	1.7	25.0	2.3	5.4
	6.9	211	2.2	46.5	3.9	12.7
4	3.0	191	2.0	7.2	2.8	2.7
	5.9	222	2.4	15.5	4.1	7.3
	8.0	255	2.7	21.5	5.0	11.1

Column: 2-ft. I.D. sectional, 30° cone.
Bulk density: 20 lb. per cu. ft. at 30% H_2O (D.B.)

Table II. Summary of Drying Data on 5/8 in. Wood Chips

Run No.	A	B	C
Bed height, ft.	1.0	1.0	1.5
Feed rate, wet lb./hr.	285	255	199
dry lb./hr.	100	98	79
Retention time, min.	2.5	2.6	4.8
Air rate, c.f.m.	180	180	180
Air/Feed, lb./lb.	7.9	8.1	10
Temperature, inlet air °F.	1114	928	751
outlet air °F.	412	349	301
wet bulb °F.	155	149	140
product °F.	189	177	167
Water content, feed %D.B.	186	160	150
product % D.B.	49	58	53
Thermal efficiency, %	52	53	52
Evaporation rate, lb./hr.	136	100	87
Evaporation capacity, lb./hr./sq. ft.	173	127	111
lb./hr./cu. ft.	24	18	16

Column: 1-ft. I.D. × 7 ft. Vol.: 5.5 cu. ft. Cone: 60° Orifice: 2 in.

material could be spouted in bed depths up to 8 ft. The air rates required are given in Table I for two different orifice diameters at several different bed depths. These experimental values are about 1.6 times the air rate predicted from formula (1). The discrepancy is probably due to the fact that the particle size, distribution and, particularly, surface roughness are substantially outside the range of data for which formula (1) applies.

At these air rates the inlet orifice velocities were high, and consequently attrition effects were large. The result was a reduction in bed particle size, as well as an increased dust load. The change in particle size distribution is apparent from the data plotted on Figure 5 where size distribution curves are given for the initial bed, and for the bed after one hour of spouting. These data were obtained with an air flow of 268 c.f.m. through a 2-inch dia. semi-circular orifice. The material removed by the cyclone during the one hour test was about 9.5% of the initial bed weight. In this particular case the carry-over and particle disintegration were too high to warrant further drying experiments.

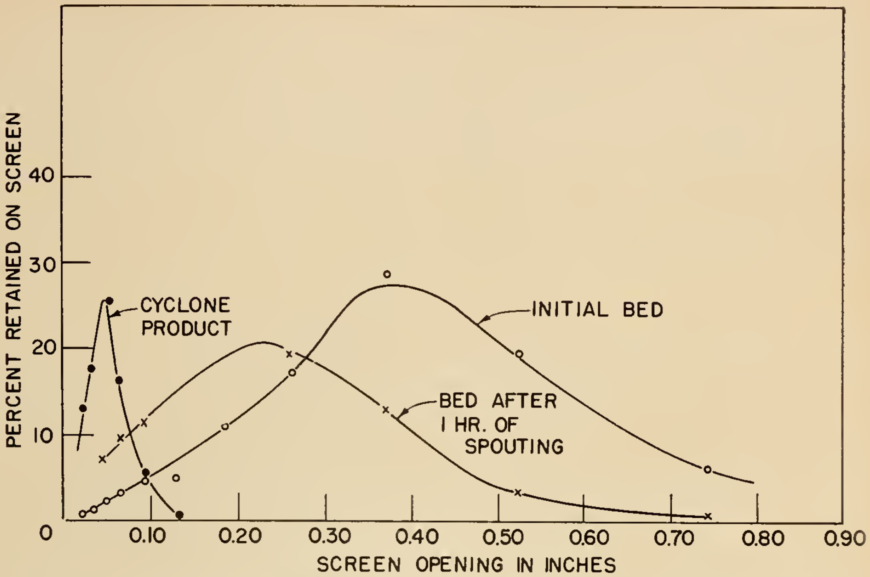


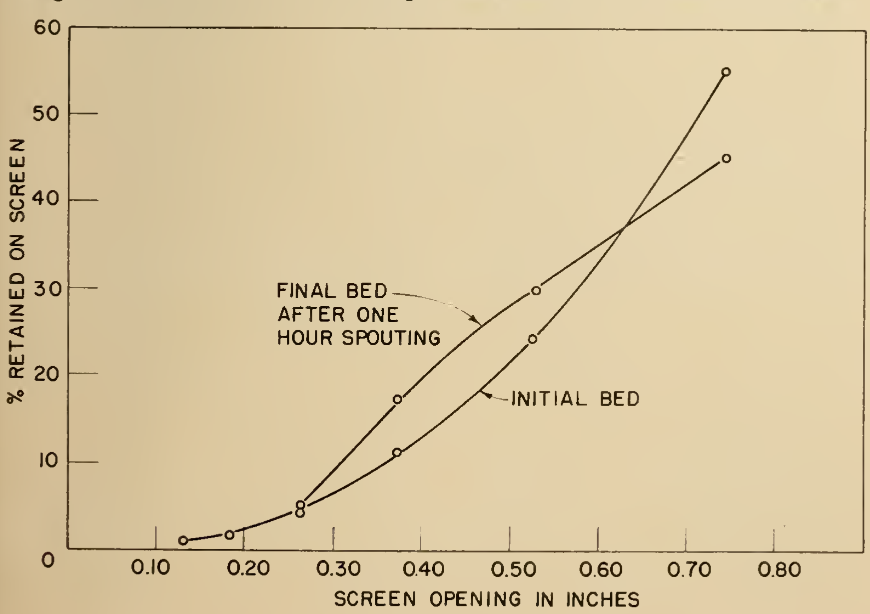
Fig. 5. Size distribution of cellulose acetate before and after one hour of spouting.

Spouting of Wood Chips

The exploratory experiments on the spouting of wood chips yielded more promising results. As in the case of cellulose acetate, the initial runs were made to establish conditions for spouting as well as the magnitude of the attrition effects. The 2-ft. dia. semi-circular column previously used for cellulose acetate was employed, though modifications in cone angle and orifice size were made in order to improve spouting behaviour. Run-of-the-mill chips were sampled by passing through a 1-in. slotted sifter. Slivers and chips longer than 4 in. were rejected. The size distribution of the initial bed is shown in Figure 6. The chips were generally flat in shape, the larger ones being about 1¼ in. x 1 in. x ¼ in. Again, after several trial runs, satisfactory spouting up to bed depths of 6 ft. were obtained in the 2-ft. semi-circular column.

The results of one attrition test are shown in Figure 6. The particle size distribution after one hour of spouting is compared with the distribution of the initial bed. Some reduction in particle size did occur. Fine material was recovered in a cyclone and at the end of one hour the net increase in minus 8 mesh material amounted to 2.3% of the bed weight. These data were obtained with an air flow of 783 c.f.m., using a 4-in. semi-circular orifice and an initial bed height of 4 ft. in the 2-ft. diam semi-circular column.

Fig. 6. Size distribution of wood chips before and after one hour of spouting.



Drying of Wood Chips

The initial experiments established that wood chips could be spouted without severe particle disintegration and so drying runs were undertaken with the object of estimating drying capacity and thermal efficiency. Details of drying runs have been described fully elsewhere[1] and, therefore, only a summary need be given here.

The drying runs were done in a one-foot diam. 7-ft. high column. The inlet air was heated by burning propane in the air stream up to a temperature of 1100°F. The feed was minus ⅜ in. screened wood chips. This size had to be used because run-of-the-mill chips could not be spouted in the one-ft. diam. column available for the drying tests. The initial water content was about 150% based on bone dry material (D.B.), and the final water content desired was 50% moisture (D.B.).

Data from a few typical runs are given in Table II. In each of these runs a few chips were charred, but the main bed was undamaged as far as a visual examination could ascertain. The charred chips were caused by lodging in the orifice, and a re-examination of the orifice indicated that this difficulty might, in fact, be fully overcome by careful design.

Examination of the data shows that the chips were dried from 150% to 50% moisture (D.B.) using retention times in the range of 2 to 5 minutes. High drying rates were obtained. The water evaporated was from 100 to 175 lb/hr/sq. ft., or on a volume basis 15 to 25 lb/hr/cu. ft. The corresponding figures for a rotary drier are given by Lapple and Clark[3] as 0.2 to 10 lb/hr/sq. ft. or 3 lb/hr/cu. ft. The fraction of the available heat which actually evaporated water, designated here as thermal efficiency, was only 52%. This is appreciably lower than the 65% figure previously obtained by Mathur and Gishler[5] in a spouted bed wheat drier. It is believed, however, that this efficiency would have been improved if much deeper beds could have been used. It has been estimated[1] that a 2-ft. diameter spouter with a 6-ft. depth of bed could be used to dry about a ton per hr. of run-of-the-mill chips from 150% moisture to 50% moisture (D.B.). Inlet and outlet air temperatures as given in run A were assumed in this calculation. These experiments terminated the work with wood chips but obviously more is required on scaling up factors before a commercial-size drier could be built.

The main attempt thus far in utilizing the spouted bed technique has been in drying of large particles which do not fluidize well. Its use in other chemical processing operations has not been investigated as yet, though it is being tried in a new clay activation process under study in our laboratories[7]. Thus, the spouted bed technique remains at the moment an interesting and potentially useful contacting method which has not yet gone beyond the laboratory level. It needs further development work in larger units before its commercial value can be reliably assessed.

References

1. Cowan, C. B., Peterson, W. S., Osberg, G. L. Drying of wood chips in a spouted bed. Pulp and Paper Magazine, No. 12, 139 (1957).
2. Klassen, J. and Gishler, P. E. Heat transfer from column wall to bed in spouted, fluidized, and packed beds. Can. J. Chem. Eng., **36**, 12 (1958).
3. Lapple, W. C. and Clark, W. E. Drying methods and equipment. Chem. Eng., Oct. Nov., 1955.
4. Mathur, K. B. and Gishler, P.E. A technique for contacting gases with coarse particles. A.I. Ch.E. Journal **1**, 157 (1955).
5. Mathur, K. B. and Gishler, P. E. Application of the spouted bed to wheat drying. J. Appl. Chem. **5**, 620 (1955).
6. Mathur, K. B. and Gishler, P. E. Mass transfer in liquid spouted bed. (Not published.)
7. Peterson, W. S., McIlhinney, A. E. and Farnand, J. R. Activation of clay. (Not published.)
8. Thorley, B., Mathur, K. B., Klassen, J. and Gishler, P. E. Design variables in spouted beds. (Not published.)
9. Vener, R. E. Moving bed processes. Chem. Eng. **62**, no. 7, 175 (1955).

The Altitude Test Facility at Orenda Engines Limited

(Continued from page 59)

separate functions and, to ensure easy communication, a suitably sound-treated common control room is provided. The room is air-conditioned to avoid the errors in instrument readings and the damage to expensive equipment that would result from fluctuating temperatures and excessive humidity.

On one side of the room, the engine monitoring and data display instrumentation surrounds the control console, a vantage point from which the operator can view the test cell through an observation window. On the opposite side of the room a large panel graphically displays the entire process air system and depicts the flow circuit in operation and the state of valves and the other equipment by the illumination of lamps at each of the control points. Consoles containing switchgear, amplifiers, and controls for all aspects of the process air system face the graphic panel, and a warning system will indicate irregular operation wherever it may occur. Safety interlocks are provided to ensure that operation cannot possibly commence without valves and controls being correctly positioned for the selected flow circuit, and so that the possibility of damage due to operators errors in other respects is minimized.

Explosion and Fire Protection

The possibility of fire or even explosion cannot be ruled out when a building of this nature is being designed. As is the case with so many test establishments in which volatile fuels are used, leaky fuel lines or engine components make possible the introduction of combustible contaminants into the air and, if present in a favourable air/fuel mixture ratio, these gases could conceivably ignite at the next engine light up. The possibility of engine or afterburner false starts or flameouts introduces another means whereby combustible fluids may become introduced into the atmosphere, and therefore to protect the facility, personnel, and test engine from hazards such as these, the following remedial measures were taken.

The first consists of a means of continually sampling the atmosphere in the explosive regions to detect a critical air-fuel ratio and the second provides for relief of the damaging pressures that would occur after an explosion has been initiated. Explosion pressures are relieved by venting the entire region to atmosphere, in a sufficiently short time, through an adequate total area of explosion ports. In such a system two factors are of fundamental importance: the condition of explosion must be detected before it reaches unmanageable proportions and the relief vents must be opened extremely rapidly. The method to be used can take one of two forms, either relief by bursting a diaphragm set to fail at a pre-determined pressure that is just in excess of the maximum to be anticipated under normal operating conditions; or the release of the vents by explosive bolts or detonators fired by an electrical signal from a detector sensing pressure level or rate of pressure rise.

The possible collection of fuel in the engine bay and the gas cooler also presents a considerable fire hazard and, although control can be exercised by the injection of CO_2, sufficient notice of the commencement of a fire cannot be guaranteed when the only means of vision is through windows in the side of the closed vessel. To overcome this difficulty, temperature sensitive co-axial cable will be laid in critical regions and a warning signal transmitted to the control room should the temperature exceed the maximum to be expected from normal operation. Further, in the engine section of the test chamber, water spraying will be installed for washing through suitable drains any collection of fuel on the lower portion of the chamber wall.

Acknowledgements

The author wishes to thank Orenda Engines Limited for the opportunity to present this paper and his colleagues Mr. T. McCloghry and Mr. H. W. Stokes for their generous assistance.

Saskatchewan River Generating Station of Saskatchewan Power Corporation

R. R. Keith M.E.I.C.

Assistant General Manager in Charge of Operations, Saskatchewan Power Corporation

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CONSTRUCTION WORK is in progress on the Saskatchewan Power Corporation's new Saskatchewan River generating station. Post World War II growth of electric load in Saskatchewan has been in the order of 20% per annum and this rate of growth is continuing and is expected to continue at the same rate for the next five to ten years at least. This rapid load growth requires continually expanding generation and transmission facilities and, about five years ago, reached proportions which would economically justify an integrated generation and transmission network throughout most of the settled area of the Province.

Figure 1 is an electrical transmission map of the Province, which shows only lines of 72 kv. and up, and includes 1957 construction. The entire area is, in addition, covered by an extensive network of 25 kv. and 34.5 kv. sub-transmission lines. It will be noted that the area covered is approximately three hundred and sixty miles by three hundred and fifty miles in extent; a major portion of this area being rather thinly populated. There are two distinct load centres within this area; one with the City of Saskatoon as its hub and the other with the City of Regina as its hub. Hydro-electric development within economical reach of these two load areas is confined to development of the Saskatchewan River system. The potential sites on this system which have so far been studied have not proven to be economically justified at this time as power projects only because of the high capital cost, low winter stream flows, and the relatively low cost of thermal fuels with which hydro-electric power must compete.

There are vast deposits of lignite coal in the southeast portion of the Province, and its use for thermal generation is only limited by cooling water supplies and the high cost of long distance transmission. This thermal fuel source can, to the limits of the cooling water which can be obtained, serve the southern load area with low cost electrical energy and, at the same time, feed certain quantities of energy into the northern load area, subject to the previously mentioned limitations. The northern load area which has the City of Saskatoon as its hub, does not have local deposits of coal close by, but does have abundant cooling water facilities afforded by the South Saskatchewan River, and is quite close to the oil and gas fields of Western Saskatchewan. Even if it were economically feasible to provide power to the northern area from the low cost fuel area in the south, the matter of continuity of service cannot be ignored. In other words, it would not be advisable to attempt to feed an area as large as this from only one source. This was a factor in the selection of the location for this station.

The paper describes the factors involved in planning and design of the Saskatchewan River generating station as part of an integrated generation and transmission network. Initial plans are for four 66-Mw. turbo-generators and four steam generating units.

The new station under discussion will be connected with a station of approximately the same size which is being constructed in the lignite coalfields in south-eastern Saskatchewan by a double circuit 138 kv. link by the year 1960, making it possible to base load the most economical station within the limits of transmission line and cooling water availability and use the Saskatchewan River station as a peaking plant.

This then, in general, is the background of the problem which confronted the engineers who were given the responsibility of designing the Saskatchewan River station.

Considering the above points, a search was begun for a site with the following characteristics:

1. Close to the centre of the northern load area.
2. Adequate cooling water available.
3. Close to rail trackage.
4. Readily accessible to economical fuel sources.
5. Adequate accommodation for construction and operating personnel without the necessity of building a "Company town".

Following the usual site surveys, foundation studies, and river channel investigations, a location was chosen on the north-west bank of the South Saskatchewan River just within the southwesterly limits of the City of Saskatoon. The site selected satisfies all the conditions established above. This location is adjacent to the main trans-continental Canadian National Railway line, an important factor in that all coal fuel must be transported by rail to the site. The site location is also within one mile of the terminal station of a gas transmission loop from the Coleville-Brock area and within one mile of a large oil refinery.

After selection of the site the next step in the design of a steam electric generating station is the choice of initial steam conditions. Primarily this is merely simple arithmetic involving weighing costs of fuel against the capital cost of the plant for different steam conditions. However, one must also base these calculations on not only the present and past fuel costs but those which may be expected over the life of the station. One must also give consideration to other types of generation such as hydraulic and even atomic energy, and their probable cost in the future. Taking all these factors into consideration, steam conditions of 850 p.s.i.g. and 900°F. were chosen for the first two units of this station. The station is being constructed on the unit system, that is, each boiler turbine unit with the necessary auxiliaries are independent and not connected with any other units in the station, so far as the steam cycle is concerned. Incidentally, here is represented one of the many advantages of the unit system in that the steam conditions for future units are quite flexible and no precedence in this regard, which could influence future decisions, is set.

Present plans envisage a generating station with a capacity of 264 Mw., in which will be installed four 66-Mw. turbo-generators and four steam generating units. The present construction is for one-half of the station, the other half to be proceeded with as load conditions may dictate. Provision is made in the design to accommodate future units of at least 100 Mw. if this proves to be desirable. The first unit is scheduled for commissioning in the spring of 1958 with the second following in the spring of 1959.

Before proceeding with the detailed design work on this station, certain studies were carried out and decisions reached with regard to the station which represented what might be called "departures from designs previously used by this Utility". These were as follows:

(a) Steam conditions of 850 p.s.i.g. and 900°F. employing a straight steam cycle without re-heat was decided upon as has been previously mentioned. A regenerative feed heating cycle employing five extractions from the turbine was selected.

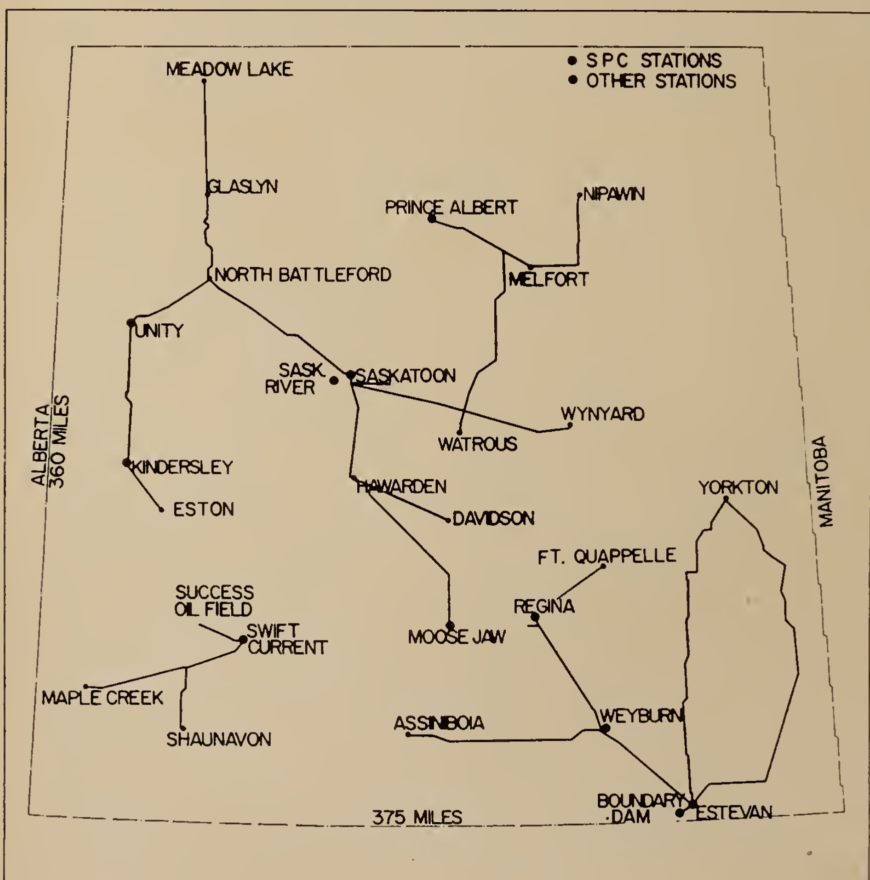
(b) In order to reduce the construction costs and arrive at what is thought to be a better operating and maintenance arrangement, it was decided to locate what is generally termed as "the basement floor elevation" at or near grade, with the operating floor 30 ft. above grade. With perhaps the exception of the turbo-alternator itself, a good deal of the heavy auxiliary equipment in a thermal station is located below the main boiler and turbine units in a basement, and the matter of access to this equipment directly from grade outside the building is important. This includes pulverizers, feed pumps, and other miscellaneous auxiliaries which are either maintained in place or, on occasion, removed from the building. All major auxiliaries such as pulverizers and feed pumps are accessible to a motor truck which can be driven into the plant on the lower floor. This type of building does have the disadvantage of adding some pumping head to the cooling water system since the condenser cannot be located near or at normal river level, but this can be overcome in part by using a syphon system.

(c) A somewhat non-conventional arrangement of the four units is planned in this station in that the four steam generating units will be arranged in a square pattern in the centre of the station with two turbine rooms each containing two units laying alongside, on each side of this square. The design provides a very compact arrangement from the standpoint of centralized control and will result in some saving in cost of the building and installation of equipment. The only increased cost of this arrangement appears to be the purchase of a second engine room crane. Figure 2 shows this arrangement in plan, and it can be noted that it results in an "H" shape building and that the draught equipment and stacks are located on each side of the plant between the two turbine room buildings protruding on each side and forming the legs of the "H". Figure 3 shows a cross section through the firing aisle facing the boilers. Figure 4 shows a cross section through the turbo-generator room looking toward the boiler room.

It will be noted that this arrangement is not expandable beyond four units. This may be considered a disadvantage, but other items such as coal-handling and cooling-water facilities normally limit any station to the expansion planned for initially. As more capacity is required in the area other plants will be constructed which will, no doubt, contain larger more efficient units.

(d) It was decided to attempt to reduce building costs by use of some form of semi-outdoor construction, and this feature has been adopted by exposing one side and the rear of each of the four boilers from engine room roof level to boiler top level. By this method, only the gaps between

Fig. 1. System map.



each boiler on all four sides of the boiler room have been closed in with insulated metal panels on building and boiler steelwork, leaving one side and the rear of each boiler exposed. A roof is added over the whole area. The boilers are designed so that an operator does not have to go outside during normal operation. All soot blowers are operated from the enclosed side of the boiler. Taking into consideration the increased cost of boiler installation, it is estimated that this method will reduce the cost of this station by five to six dollars per kilowatt of installed capacity. Figure 5 illustrates this type of construction.

(e) The matter of a centralized station and system control room required considerable study and since this location must also contain a dispatching headquarters for the northern system, it was decided to construct a separate building near the station in which all system control would be located, together with the station administrative offices. The station control room, therefore, is limited to control of boiler turbine units. Synchronizing and loading of the units is to be carried on from the system control room.

(f) In the matter of fuel handling, coal fuel, of course, requires the greatest amount of equipment and, consequently, a large expense. Facilities for handling of either natural gas or oil can readily be expanded, as the use of these fuels increases, at a minimum of expense and require relatively little space. The coal handling plant is costly and can occupy a considerable amount of space for storage and the necessary switching trackage. Since, in the foreseeable future, all three fuels, namely, natural gas, bunker oil, and coal will be available for use in the station in varying quantities at competitive prices, there appeared to be no other alternative but to design this station originally to use all three fuels.

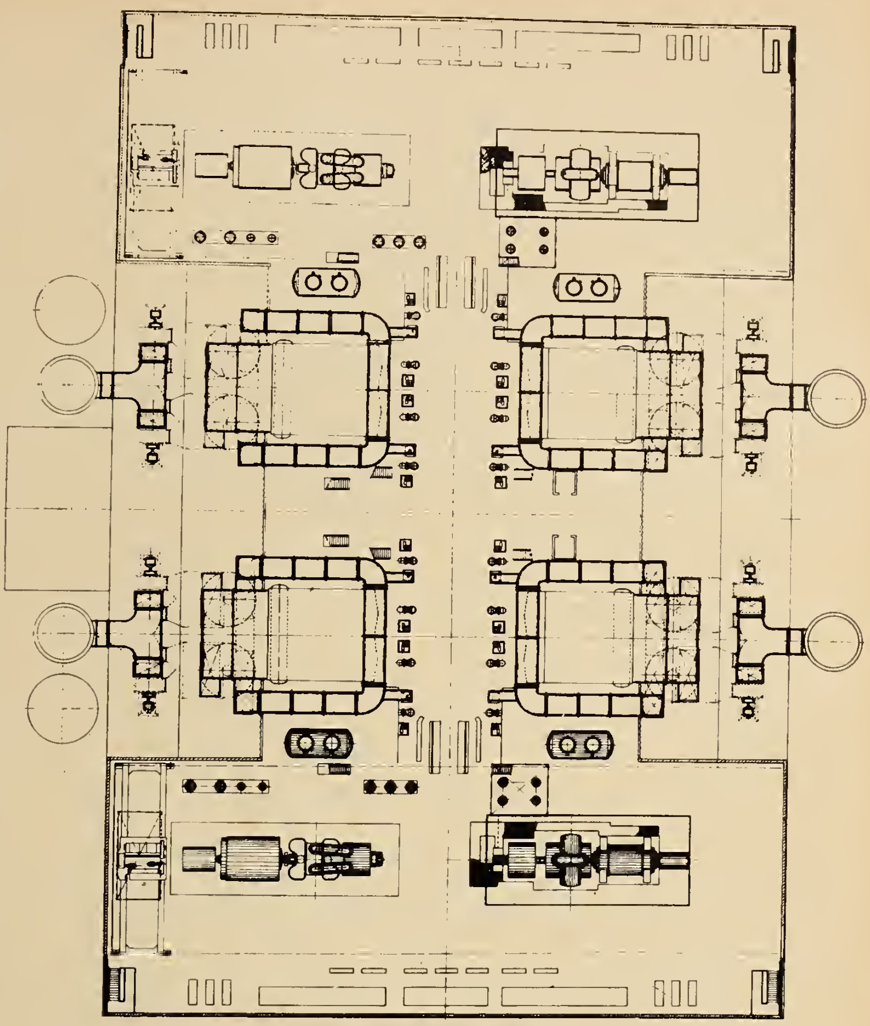
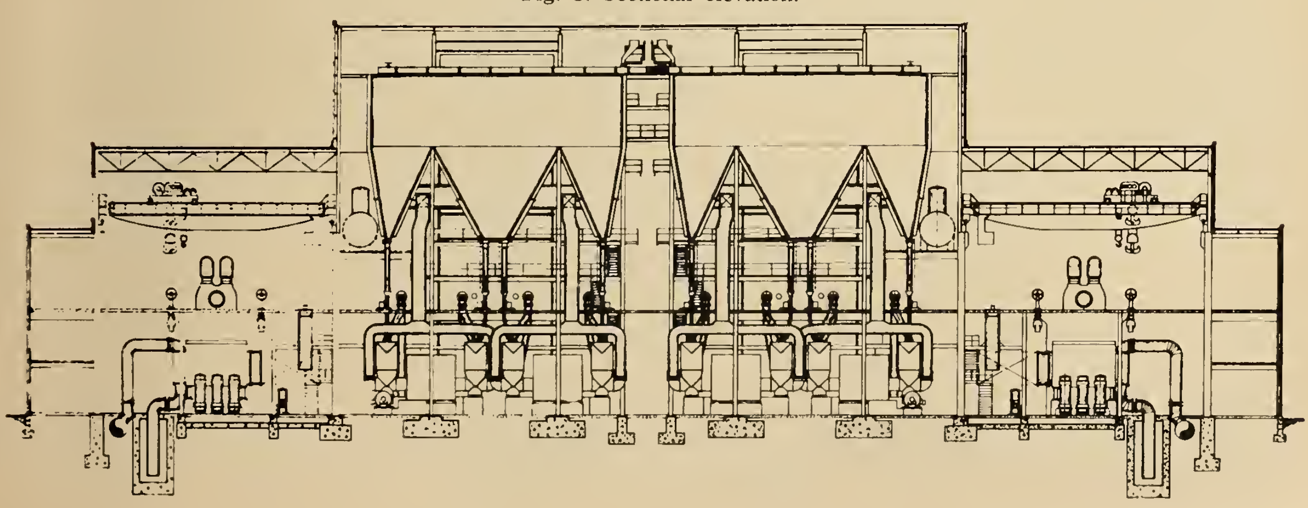


Fig. 2. Operating floor plan.

(g) In designing a unit station, the question of how far this unitization should go within the design and choosing of certain auxiliaries was given considerable study. From these studies, it was decided that the cooling water system would be unitized in two separate systems to serve a four-unit station. Each of the two cooling water systems will have three pumps to serve two units. Normally two pumps will be in service with

Fig. 3. Sectional elevation.



one standby. The coal handling system, of course, will serve all four of the station units.

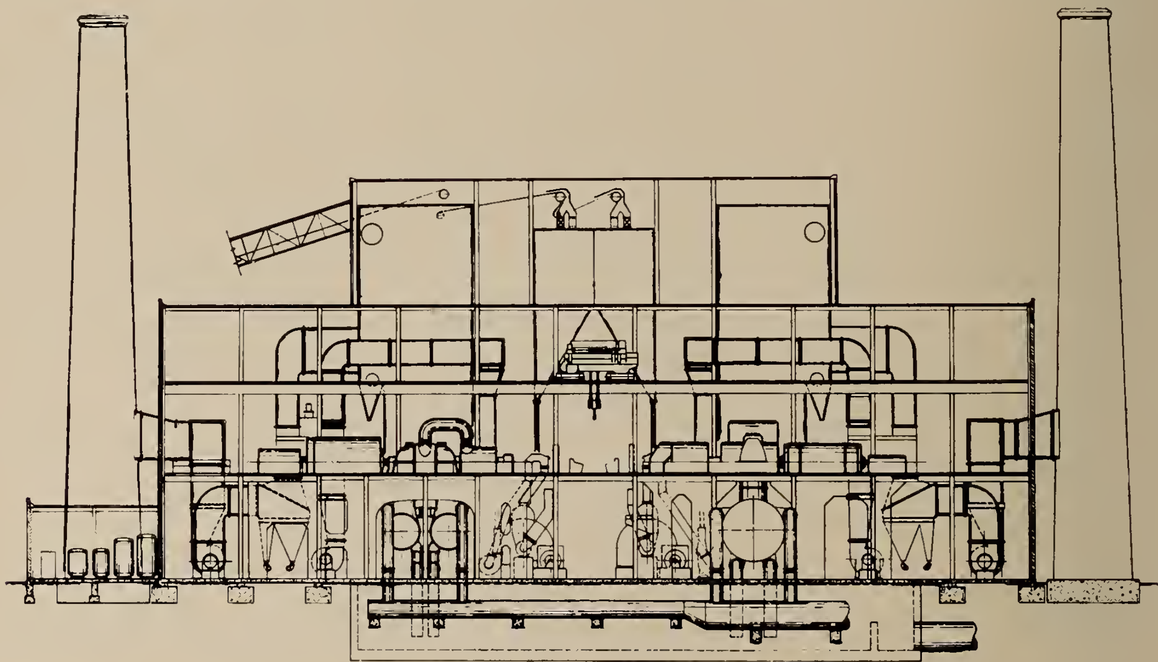
The foregoing decisions provided, in the main, the general terms of reference for the design of this station. Before going into detail as to the description of various pieces of equipment and their specifications, Figure 6, showing the general site layout, should be noted and will illustrate many of the features discussed in the foregoing.

Buildings

The power plant will be enclosed with a combination of Saskatchewan brick, which is light buff in colour, and insulated metal panels. The turbine rooms, electrical bays, and fan rooms will be of brick. The upper portion of the boiler room will have aluminum panels supported from the building and boiler steelwork. The chimneys are of buff-coloured radial brick which appeared to blend best with the Saskatchewan brick. The power plant will have ventilating fans arranged to supply filtered air to maintain the inside of the building at a slight positive pressure. The forced and induced draught fans are in an enclosed room, and air for the forced draught fans will be introduced separately so as not to interfere with ventilating boiler and turbine rooms.

The adminstration and control building contains the plant offices and system control room, as previously mentioned, and a large lecture room which can be used for training, safety meetings, conferences, and other purposes. This building is finished with a combination of brick, enamelled metal panels, and glass, and is completely air conditioned. There is an enclosed walkway connecting this building with the power plant. A tunnel under this walkway contains control and alarm circuits, and service piping. Located at the rear of the power plant are auxiliary buildings constructed of concrete block and metal panels, which serve as a diesel locomotive and tractor shed, and a stores and machine shop building.

The pumphouse building, above the concrete, will be of Saskatchewan brick to blend with the power plant.



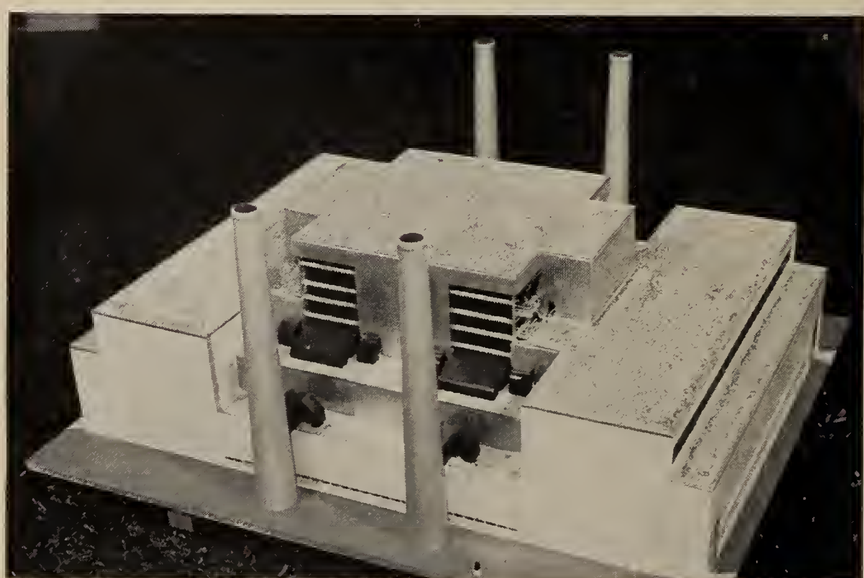


Fig. 4. Sectional elevation. Fig. 5 (below): Model of station.

Steam Generating Units

The steam generating units are designed for a continuous output of 600,000 pounds of steam per hour and 660,000 pounds per hour for four-hour peaks with steam at 870 p.s.i.g. and 910°F. total temperature at the superheater outlet. Figure 7 shows a sectional elevation of the steam generating unit. The boiler furnace is completely water cooled and has a water impounded type of ash hopper. The superheater is of the combined radiant convection type. The radiant section forms the front wall and roof of the furnace; the convection section being of the cross flow pendant type is located immediately behind a row of screen tubes in the upper part of the furnace. This type of combined radiant convection superheater has an inherently flat temperature/load curve. However, since steam temperature varies widely with the fuels to be used, additional steam temperature control equipment is required. This is provided in the form of a condenser located in the inlet header to the radiant superheater section. The final temperature is controlled by varying the quantity of boiler feed water passing through this condenser. Figure 8 is a schematic of the steam temperature control system. Each steam generating unit will have two induced draught and two forced draught fans. The ducts and dampers are arranged so that the unit may be operated at reduced load with one set of fans, one air heater, and one dust collector in service. The dust collectors are installed between the boiler and the air heater. Each unit is equipped with two pulverizers of the ball mill type suitable to handle coal crushed to ¾ in. minus. Two separately-driven exhausters per pulverizer each deliver fuel to two of the eight burners, which are suitable for burning pulverized coal, natural gas, or oil, or a combination of these fuels.

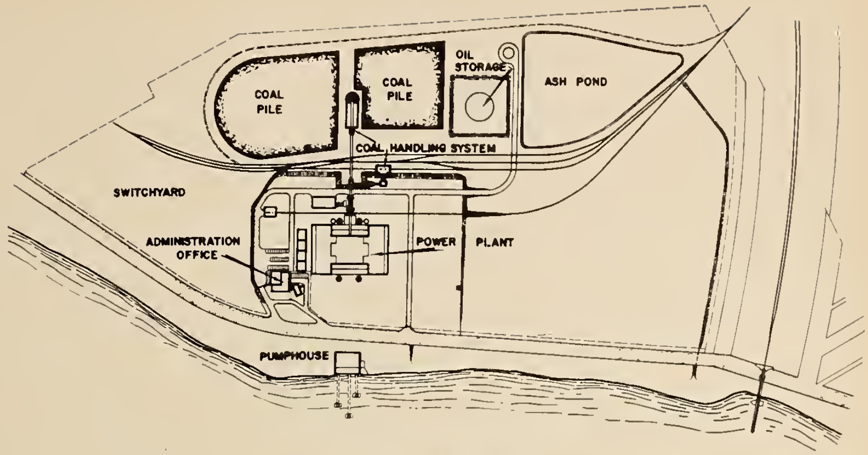


Fig. 6. Site layout.

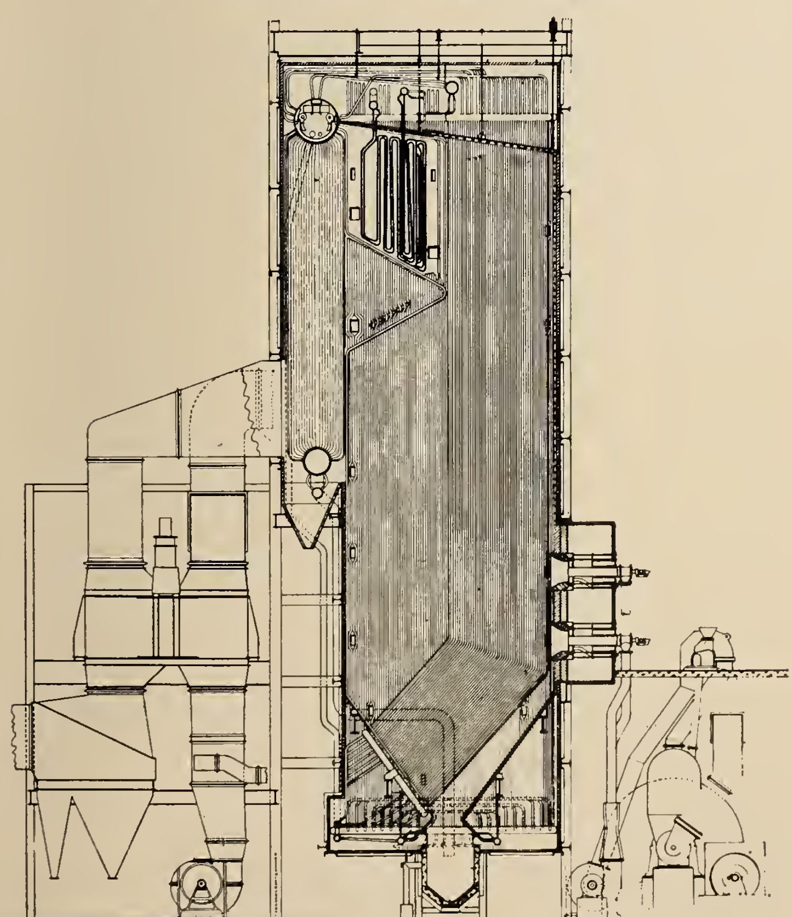
The table of Figure 9 outlines pertinent design data and the predicted performance of the units at 600,000 lb. per hr. when burning Forestburg coal.

Boiler No. 1 is to be equipped with two 100% capacity boiler feed pumps with totally enclosed water-cooled motors. In addition, a 50% capacity steam turbine driven feed pump is provided to facilitate feedwater regulation at very low loads during start up and shut down.

Boiler No. 2 is to be equipped with two 60% capacity motor driven boiler feed pumps. The turbine driven feed pump referred to above will be piped up so that it may also be used as standby for the motor driven pumps on No. 2 unit. Space has been left for the addition of a third 60% motor driven pump if this proves to be desirable.

All boiler feed pumps will be equipped with automatic thermal by-passes to prevent damage to any pump from over-heating at light loads.

Fig. 7. Sectional elevation through steam generator.



Turbo-Generators

Unit No. 1 is nominally a 66 Mw. unit but the turbine has a maximum capability of 75 Mw. The generator is capable of delivering 75 Mw. at 80% P.F. by increasing the hydrogen pressure from a normal 10 p.s.i.g. to 30 p.s.i.g. At the most economical rating of 50 Mw. the turbine water rate is 8.22 lb. per kwh. The turbine is a conventional two-cylinder single-shaft 3600-r.p.m. machine with five extraction points for feed water heating. The feed heating system consists of two low-pressure closed heaters, a deaerating heater, and two high-pressure closed heaters. The turbine blading consists of one velocity compounded impulse stage and 32 reaction stages, 20 of which are in the HP cylinder and 6 in each part of the double-flow LP cylinder. The turbine is direct-connected to the two-pole 3-phase 60-cycle, 14,400-volt generator. The exciter and pilot exciter are direct connected to the generator.

The condenser is a single shell type with two water passes and divided water boxes, which permit one-half of the condenser to be cleaned while the turbine remains in service at reduced load. It has 57,000 sq. ft. of heating surface and requires 60,000 g.p.m. of cooling water at 65°F. to maintain the design exhaust pressure of 1.2 in. Hg at 66 Mw.

Unit No. 2 is a 66 Mw. C.M.E.R. machine, that is, the most economical rating is equal to maximum continuous rating of 66 Mw. The generator is normally operated at a hydrogen pressure of 30 p.s.i.g. The turbine water rate is 8.43 lb. per kwh. at 66 Mw. Similar to No. 1, this turbine is a conventional two-cylinder single-shaft 3600-r.p.m. machine with five extraction points. However, the blading consists of one velocity compounded impulse stage and 18 pressure compounded impulse stages in the HP cylinder, and one impulse and 6 reaction stages in each part of the double-flow LP cylinder. The regenerative feed heating system consists of one closed LP heater, one open type deaerating heater, and three closed HP heaters. The turbine is direct-connected to the two-pole, 3-phase, 60-cycle, 14,400-volt generator, but the exciter and pilot exciter are geared to the generator shaft and operate at 1200 r.p.m. This unit is being designed to operate at low kw. loads and low loading power factor for power factor correction on the system.

The condenser is of the twin shell design with two water passes and a total heating surface of 48,000 sq. ft. It requires 36,000 g.p.m. of cooling water at 65°F. to maintain the design exhaust pressure of 1.5 in. Hg.

While there appears to be a vast difference in the surface and water requirements of the two condensers it should be remembered that No. 1 condenser must be capable of handling the steam flow at 75 Mw. The condenser for No. 2 machine was deliberately purchased smaller than the normal practice of this Utility in the past in the interests of economy of first cost and water pumping cost. It may be necessary to reduce load slightly when water temperature exceeds 75°F. This condition only occurs in years of abnormally high ambient air temperatures.

Instruments and Controls

Each half of the generating plant will have a control centre, located between the boiler and turbo-generator bays, on the operating floor, from which point two units will be operated. The control centre will not be totally enclosed but will have an acoustic ceiling over the area. Full automatic combustion control will be achieved on the steam generating unit when burning any one of the three fuels. When two fuels are burned simultaneously the predominant fuel will be on automatic control with the supplementary fuel on manual control. Safety interlocks are provided on fuel supply, igniters, and fans to ensure adequate purging prior to lighting off, and to limit the amount of fuel in the event of failure of any fan. Supervisory instruments will be installed at the turbo-generator for the use of the operator in starting up; these, however, will be duplicated at the control centre. The control centre panels will contain all indicating and recording meters and instruments required for plant operation and records. Control consoles will contain all switches and controls required for the operation of the plant, except for the hydrogen cooling system, which will have separate panels at each generator. An adjustable load limit control will be provided on the console so that the plant operator can limit the maximum load on the units in the event of trouble or unusual conditions. An alarm system will have the annunciator panel at the control centre. Continuous communication will be provided between the station control centre and the system control room, and a telephone intercom system will connect all parts of the station.

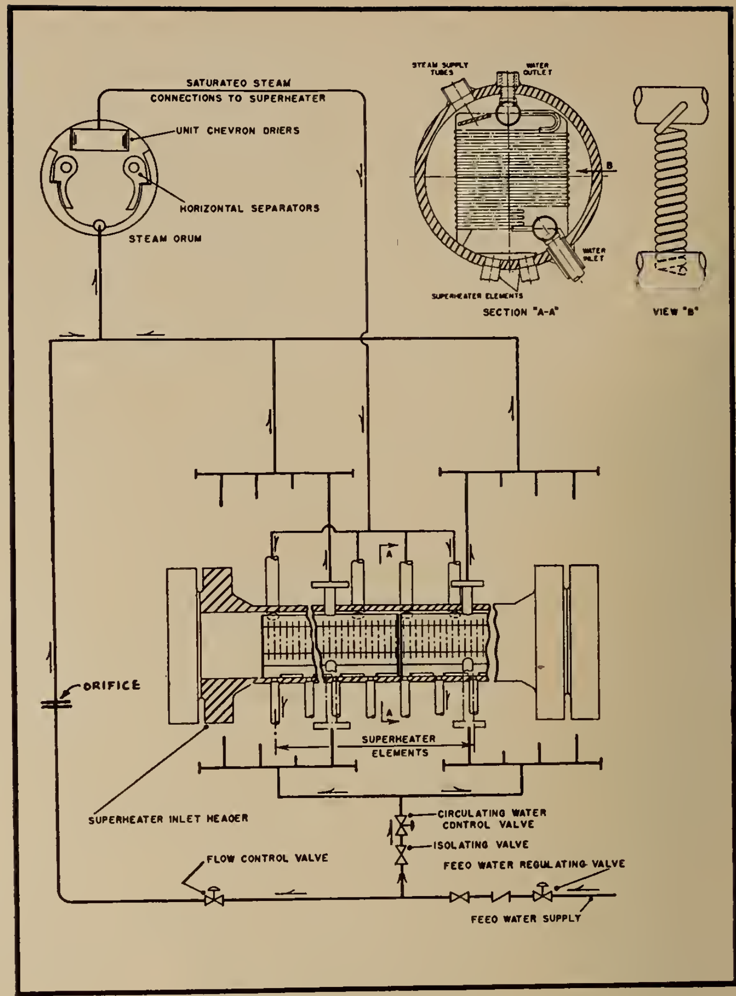


Fig. 8. Steam temperature control system.

Fuel Handling

The coal to be used will be brought by rail from the Alberta coal fields to a siding adjacent to the railway line outside the station site. The Corporation's diesel locomotive will shunt the cars to the unloading track, and will return the empties to a location adjacent to the main line. Figure 10 is a sketch of the coal handling system. Since up to fifty cars of coal per day will be handled when the station is completed, a rotary car dumper is being installed. The cars will be fed to this dumper by the diesel locomotive. Since slack coal may not always be available, primary and secondary crushers to handle run of mine, which may contain lumps up to fourteen inches, are being installed. An unusual feature of the coal handling system is that the primary crushers are located directly under the unloading hopper. This system practically eliminates any possibility of plugging or hanging up in the hopper or feeder when handling frozen or large lump coal. Apron feeders deliver the coal from the primary crushers to the first rubber belt.

The disadvantage of this system is that crushers have to be run even when handling slack coal in order to pass coal through them. However, the power consumption is very low under this condition. This layout of primary crushers was investigated at a large U.S. station and it appeared to be operating very satisfactorily.

The coal, after passing the secondary crusher, is conveyed to a transfer tower where it may be directed to any bunker in the power plant, to outside live storage or to the stocking out pile. It will be possible for the operator in the boiler room to fill the boiler house bunkers from the live storage by remote control. The provision of outside live storage permits smaller bunkers to be installed in the plant without the necessity of handling coal over weekends and holidays.

The conveyor under the live storage is extended to a reclaim hopper to receive coal from the outside storage piles and convey it to the bunkers. Crawler tractors with bulldozers will be used to handle the coal to and from the outside storage piles. The system is designed to handle 350 tons coal per hour initially and 700 tons per hour when the station is completed. All conveyors will be rubber belt except those over the bunkers which will be "Redler" conveyors.

The natural gas will be delivered to a metering and pressure regulating station, thence to a header with branches to the boilers; the piping being arranged so that only the branches are installed in the building.

The fuel oil will be delivered by tank truck initially to a main 125,000-barrel storage tank. At a later date a pipeline may be built from a nearby refinery if suficient oil is available. From the main storage tank the oil will flow through steam traced pipe lines to a 25,000-gallon oil service tank, thence to the oil heating and pumping set and to the burners.

Ash Removal and Disposal

A hydraulic ash handling system is to be used. Bottom ash will be sluiced from the ash hopper to a "Jetpulsion" pump, one for each boiler, which will pump the ash through a 10-in. discharge line approximately 1200 ft. long to the ash storage pond. Provision has been made to add clinker grinders at the ash hopper outlets if this proves to be desirable.

Fly ash from the boiler dust hoppers and the dust collectors will be transported in an air stream to a hydraulic ejector. The mixture of ash, air, and water then passes to an air separator where the air is removed. The air separator is located in the upper part of the boiler room permitting the mixture of ash and water to flow by gravity through the same discharge line as the bottom ash.

All fly ash intakes are controlled by an automatic sequential control system permitting the removal of fly ash to be a completely automatic operation once the system is put into service. It is expected that, when burning coal, bottom ash will be removed once per day and fly ash once per shift.

The ash pipeline discharges to a storage pond from which the water overflows to the river. The ash will be removed periodically from the ash pond and transferred to the ultimate disposal area by truck or rail. Since only one ash pond is being constructed initially it will be necessary to operate the station on oil or gas to allow the pond to drain and permit ashes to be removed. An alternative method of removing ashes from the pond by overhead dragline is at present being studied.

Circulating Water System

The circulating water pumphouse, located on the river bank, is being constructed initially for the ultimate four-unit station. However, pumps and equipment for the second stage will not be installed until turbogenerators 3 and 4 are installed.

The pumphouse structure is divided into seven wells. Six travelling screens will be installed (three initially), one for each of the C.W. pumps. The seventh well will receive water from the pump on either side and will be used for pumps to supply high-pressure water to the ash system, plant service water, and screen wash water.

Three diamond-shaped concrete intake structures are located on the river bottom about 150 ft. from the bank. Intake openings fitted with trash racks are located in the downstream faces of the diamonds. These structures are each connected to two intake wells by large-diameter concrete pipe lines below the river bed. This design of intake structure has given excellent service at other Corporation plants on the North and South Saskatchewan Rivers.

Initially, three vertical mixed flow pumps will be installed; two with a capacity of 60,000 g.p.m. and one of 30,000 g.p.m. at 37 ft. (total head). The small pump was selected to pro-

Fig. 9. Steam generator design and performance data

DESIGN DATA

Capacity: 600,000 lb./hr.—660,000 lb./hr. for four hour peaks
Design Pressure: 980 p.s.i.g. Operating Pressure: 870 p.s.i.g. Steam Temperature: 910°F.

Heating Surface

Furnace	12,040 sq. ft.
Boiler	43,550 sq. ft.
Convection Superheater	7,520 sq. ft.
Radiant Superheater	4,325 sq. ft.
Air Heater (Total for 2)	159,600 sq. ft.
Furnace Volume	51,400 cu. ft.

Auxiliaries

F.D. Fans —2–150 h.p., 900 r.p.m., capacity 452,000 lb./hr. at 6.82 in. w.g.
I.D. Fans —2–400 h.p., 600 r.p.m., capacity 524,700 lb./hr. at 9.44 in. w.g.
Pulverizers—2 ball mills, 700 h.p. 327 r.p.m., capacity 50,100 lb. coal/hr.
Exhausters—4–100 h.p., 1200 r.p.m.
Feed Pumps—2–1400 h.p., 3600 r.p.m., capacity 725,000 lb./hr. at 1140 p.s.i.g.

Performance @ 600,000 lb./hr. Burning Forestburg Coal @ 8480 Btu./lb. as fired

Heat Losses

Dry gas	4.95%
Hydrogen and moisture in fuel	6.62%
Moisture in ash pit	0.43%
Unburned carbon	0.22%
Radiation	0.32%
Unaccounted	1.50%
Total	14.04%

Fuel burned 91,900 lb./hr.
Comb. rate, 15,100 Btu/hr.cu. ft.
Total draught loss 7.25 in. w.g.
Air pressure loss 5.05 in. w.g.
Excess air 18%
Boiler outlet temp. 1895°F.
Air heater gas outlet temp. 280°F.

Calculated Efficiency 85.96%

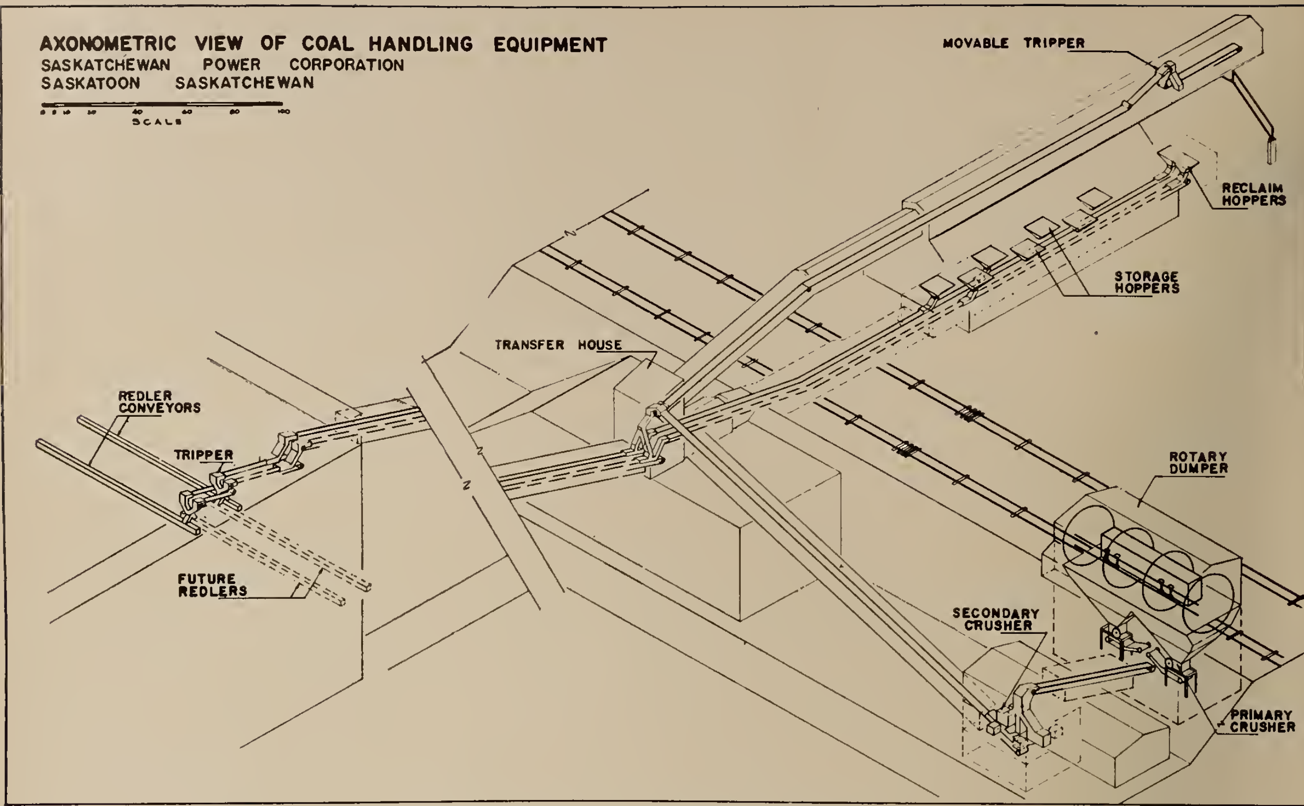


Fig. 10. View of coal handling equipment.

vide good flexibility with water temperatures fluctuating from 34°F. to 80°F. while still providing adequate standby.

An interesting feature that should be noted is the absence of check valves on the discharge of these pumps, which are connected to a common header. Butterfly valves on the discharge of each pump are interlocked electrically with the pump so that the valve cannot open until the pump is started and the valve automatically closes if the pump stops for any reason. These valves are operated from a hydraulic system, which contains a high pressure reservoir with sufficient capacity to close all valves if this is required during a failure of the electrical supply to the hydraulic pump. A similar system has operated satisfactorily at other plants in the Corporation's system, and the butterfly valves have proven to be extremely reliable. Rubber seated butterfly valves are used throughout the C.W. system.

The discharge of the three pumps is connected to an 8-ft. diameter steel pipe, which will deliver the water to the condensers of units No. 1 and 2. The pipe is coated and wrapped with a plastic tape to protect it against soil corrosion. All joints are welded, and expansion joints provide for the movement that takes place with water temperatures varying from 34°F. to 80°F. The pipeline is installed on concrete pile foundations.

The outlets from the condensers discharge into a common concrete duct, which passes under the station floor. This duct contains a weir, which controls the maximum syphon head on the discharge lines. Water flows over the weir to a 9-ft. diameter concrete pipe which discharges to an outlet structure on the downstream side of the pumphouse. Provision is made to recirculate warm discharge water to the inlet wells to prevent freezing troubles under severe winter conditions. It is not expected that chlorination of circulating water will be required. Experience on the Saskatchewan River indicates that sand and silt in the water effectively scours away any fouling or build-up that might occur.

Service Water

The pumphouse contains service water pumping, and treating facilities, as well as the necessary chemical storage. Water used for bearing and motor cooling and the like will pass through a clarifier to a clear well from where it will be pumped to the service required.

Domestic water will be taken from the clear well and will pass through gravity filters, before being chlorinated and delivered to the domestic water main.

The high-pressure ash sluice pumps will also be used as emergency fire pumps.

Feed Water Treating

The feedwater treating plant is located at the west end of the main power plant. Makeup water will be pumped from the clear well in the pumphouse to twin four-bed demineralizer units in the feedwater treating plant. Two 10,000-gallon tanks are provided for the bulk storage of sulphuric acid and caustic used for regeneration of the demineralizer. The regeneration cycle is automatically controlled by a program timer operating diaphragm valves. The conductivity and pH of the effluent from each bank is continuously recorded and either bank is automatically shut down if the conductivity reaches a pre-determined level. The product from the demineralizers will contain less than 2 p.p.m. of dissolved solids and will have a soluble silica content of less than 0.02 p.p.m. The product will be stored in two (initially one) 90,000-gallon storage tanks from where it will be pumped to the cycle as required.

Main Power Electrical System

The generators are directly connected by a 4,000 amp. isolated phase bus duct to the low-voltage terminals of the main 75 Mva., 14.4/138 kv. step-up transformers, which are located outside and adjacent to the turbine room. Overhead lines connect these transformers to the switching site which connects each unit to the 138 kv. Provincial grid system. Figure 11 is a simplified one line diagram of the main power and station auxiliary electrical systems.

Station Auxiliary Electrical System

Under normal running conditions, each unit will supply its own auxiliary power from a 6 Mva., 14.4/4.16 kv. transformer which is connected directly to the main bus duct between the generator and main step-up transformer. All motors over 150 h.p. such as pulverizers, boiler feed pumps, etc., are served directly from the 4160 volt unit bus. A 500 kva., 4160/480 volt transformer supplies smaller motors at 480 volts for each turbo-generator and a 600 kva., 4160/480 volt transformer supplies 480 volt loads for each boiler.

Auxiliaries common to more than one unit are served by a 10 Mva., 138/4.16 kv. station auxiliary transformer. Ash sluicing pumps and one standby circulating water pump are supplied directly at 4160 volts. Smaller loads are supplied from this bus through 4160/480 volt transformers located near the various load centres. These include a "station essential" bus which serves such items as the water treating plant; a "station general" bus which serves heating and ventilating equipment, cranes, etc.; a 480 volt bus to serve coal handling equipment, and a 480 volt bus to serve the circulating water pumphouse. In addition, a standby 4160/480 volt transformer is permanently installed and wired to serve any 480 volt distribution centre in the event of a transformer failure.

The 4160 volt station auxiliary bus may be connected to either or both 4160 volt unit auxiliary buses to provide start-up power or to replace the unit auxiliary transformer in the event of a transformer failure. The station auxiliary transformer is sized to carry all essential station auxiliaries plus all auxiliaries for one unit plus start-up power for a second unit.

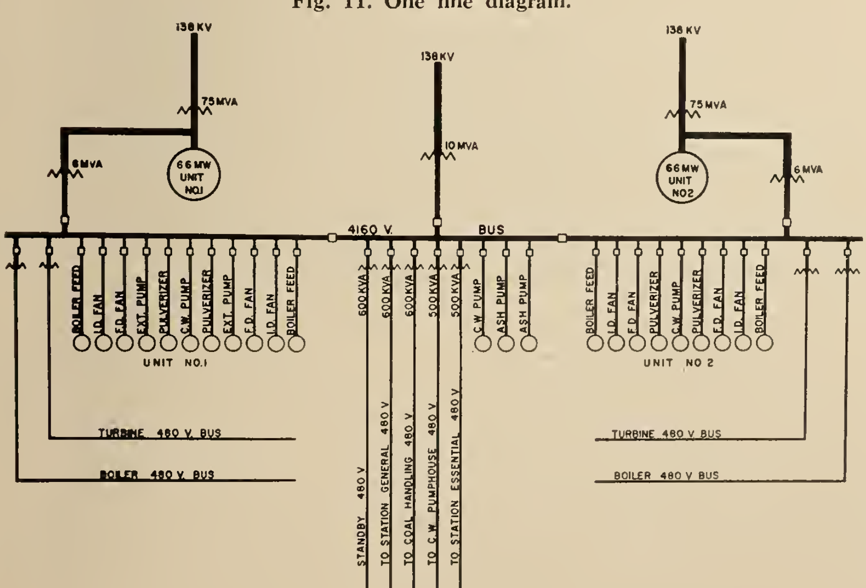
A second station auxiliary transformer of 12.5 Mva. capacity is being installed initially to provide standby for the 10 Mva. bank. When units 3 and 4 are installed, the 12.5 Mva. transformer will become the station auxiliary transformer for those units. The 12.5 Mva. capacity will allow for future 100 Mw. units if these are decided upon. In the future, standby for these transformers will be provided by an emergency tie between the 4160 volt station buses serving units 1 and 2, and units 3 and 4.

Synchronizing check relays will prevent any station service tie breaker from being closed out of synchronism.

It should be noted that there will be no oil filled electrical equipment inside the main station building. The 4160 volt circuit breakers are of the air-break type and all 480 volt and lighting transformers are air insulated and cooled. All other transformers including the main step-up transformer will be of the oil filled, natural oil circulation, forced air circulation type.

All 4160 volt cables will be of the paper-insulated lead-covered type, and lower voltage cables will be rubber-insulated, neoprene-covered, multi-conductor type. Cable dispersal will be accomplished by the use of a cable tray system routed to give an economical balance of maximum concentration and minimum cable lengths.

Fig. 11. One line diagram.



Staff Requirements

It is estimated that the staff for the first stage of the station will consist of the following: supervisory, 3; laboratory, clerical and miscellaneous, 9; operating staff, 5 shifts @ 7 men, 35; fuel handling crew, 8; maintenance crew, 12. Total, 67.

It should be explained that since the Saskatchewan Power Corporation operates on a 40-hour work week, it is necessary to maintain five complete shifts of operating staff. Since the fifth shift is normally only needed for relief 8 hours per week, advantage is taken of training junior employees in more senior positions during the periods that two shifts are on duty at the same time.

Experience in actual operation of the station will be needed to determine if this estimate of staff requirements is accurate. It will, of course, not be necessary to double this staff when units 3 and 4 are added to the station.

Capital Cost

The total cost of the first stage of this station is estimated to be $18,950,000 ($143.50 per Kw.) including all land, improvements, and the step-up substation, but not including the high voltage switching station, which is logically considered part of the transmission system.

If units 3 and 4 are also 66 Mw. units, the ultimate cost of the station is estimated to be $35,913,000 ($136.00 per Kw.) based on present day construction costs.

Acknowledgments

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The AASHO Road Test

Gordon G. Campbell, JR.E.I.C.

Director of Technical Services, Canadian Good Roads Association.

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NEARLY EVERYONE present today is aware of the severe limitations of the body of knowledge which we, as engineers, are forced to rely upon in the design, construction, and maintenance of roads and streets. All of us associated with highways are daily seeking answers to the numerous complex problems in our field. Such problems can only be solved through research, whether this is done by the resident engineer who incorporates some new innovation in the construction of his section of road, or whether it is done in a laboratory by a trained research specialist, using complex scientific equipment and instrumentation methods.

Research is a continuing thing in almost every country today. This is evidenced by the numerous papers and reports presented at the annual meetings of the Canadian Good Roads Association and the Highway Research Board. As practising engineers, we must endeavour to keep abreast of all such developments in our special area of interest.

I shall attempt to acquaint you briefly with the largest single highway research project in the history of road building. I refer to the $20 million AASHO road test. This project derives its name from the American Association of State Highway Officials, the agency initiating and sponsoring the experiment. The various committees of that Association spent nearly five years in planning for this test before the final prospectus was drawn up and the administration and direction of the project was turned over to the Highway Research Board in 1955. Since that time, most of the details of the design, construction, and instrumentation of the road have been worked out by the project staff, and the actual construction has begun.

The AASHO experiment will consist of the testing of both rigid and flexible pavement sections of various thicknesses and composition, and of the testing of bridges of various designs and type by means of the repeated application of both single and tandem axle loads representing a wide range of intensities. The pavement sections have been selected to be typical of good current design practice throughout the United States. They are representative of Canadian design procedures as well.

Layout of Test Loops

The test road is being constructed at Ottawa, Illinois, approximately 90 miles south-west of Chicago. It will consist of four main loops and two auxiliary loops. The principal loops, designated by the letters A through D, will each have a length of approximately 7,600 feet. They will, at the conclusion of the test, form a part of a relocation of U.S. 6, a four-lane divided limited-access highway facility. Loops E and F will be about 5,000 feet long and 2,200 feet long respectively. They are being constructed immediately adjacent and parallel to one of the main loops. All loops will thus be made up of two 24-foot roadways with 10-foot shoulders, separated by a median strip and connected at either end by turnarounds.

Loop F will not be subjected to regular test traffic, but will be used for special studies, and to evaluate the effects of weather and climate. As in the WASHO test, the inner and outer lanes of the five traffic loops will be subjected to axle loadings of different intensities. The north tangent of each loop will be provided with flexible pavement test sections, while the south tangents will contain rigid pavement test sections. The 16 test bridges of the experiment will be located in groups of four adjacent to each turnaround of two of the loops.

Experimental Design

The previous test roads proved to be valuable pilot studies for this experiment. We now know most of the characteristics of the variables to be measured, and how to go about measuring them. We have learned the value of applying mathematical statistics to the experimental design of the project. In none of the previous road tests was the experimental design established so that methods of statistical inference could be utilized in analyzing the data obtained. Therefore, it was impossible to make any probability statements as to the true influence, in all similar circumstances, of any of the variables studied.

In the AASHO road test, the methods of statistical analysis constitute the basis for the experimental design. These techniques will ensure that the maximum amount of valid information is developed from the limited test area and funds available for the project. For experimental research work of this nature, designs have been planned to allow the relationships between variables to be studied with the maximum accuracy and the minimum computation. One such class of experimental designs, the factorial design, will be used in the AASHO project. In this method, the levels chosen for each independent variable are restricted in number, but the observations are so arranged that all possible combinations of levels of the independent variables occur.

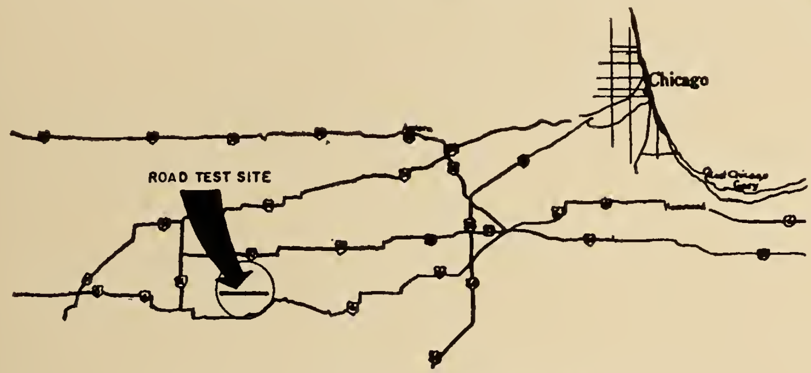
For example, in the rigid pavement

experiment, it was desired to evaluate the effects of concrete slab thickness, reinforced and non-reinforced, and sub-base thickness under various axle loadings. Thus, the design was developed with eight levels of surface thickness, each reinforced and non-reinforced, four levels of sub-base thickness and 10 axle loadings. Therefore, the primary rigid pavement experiment became an 8 x 2 x 4 x 10 factorial design. There are a possible 640 pavement sections in such an experiment. However, it was possible to reduce this design to approximately 300 sections, including some replications, by omitting sections that were obviously either too light or too heavy for specific axle loadings. The practical economical designs adopted for each phase of this study will make it possible to state with a high degree of certainty, the actual relationships existing between pavement design, axle loading and pavement performance in this test.

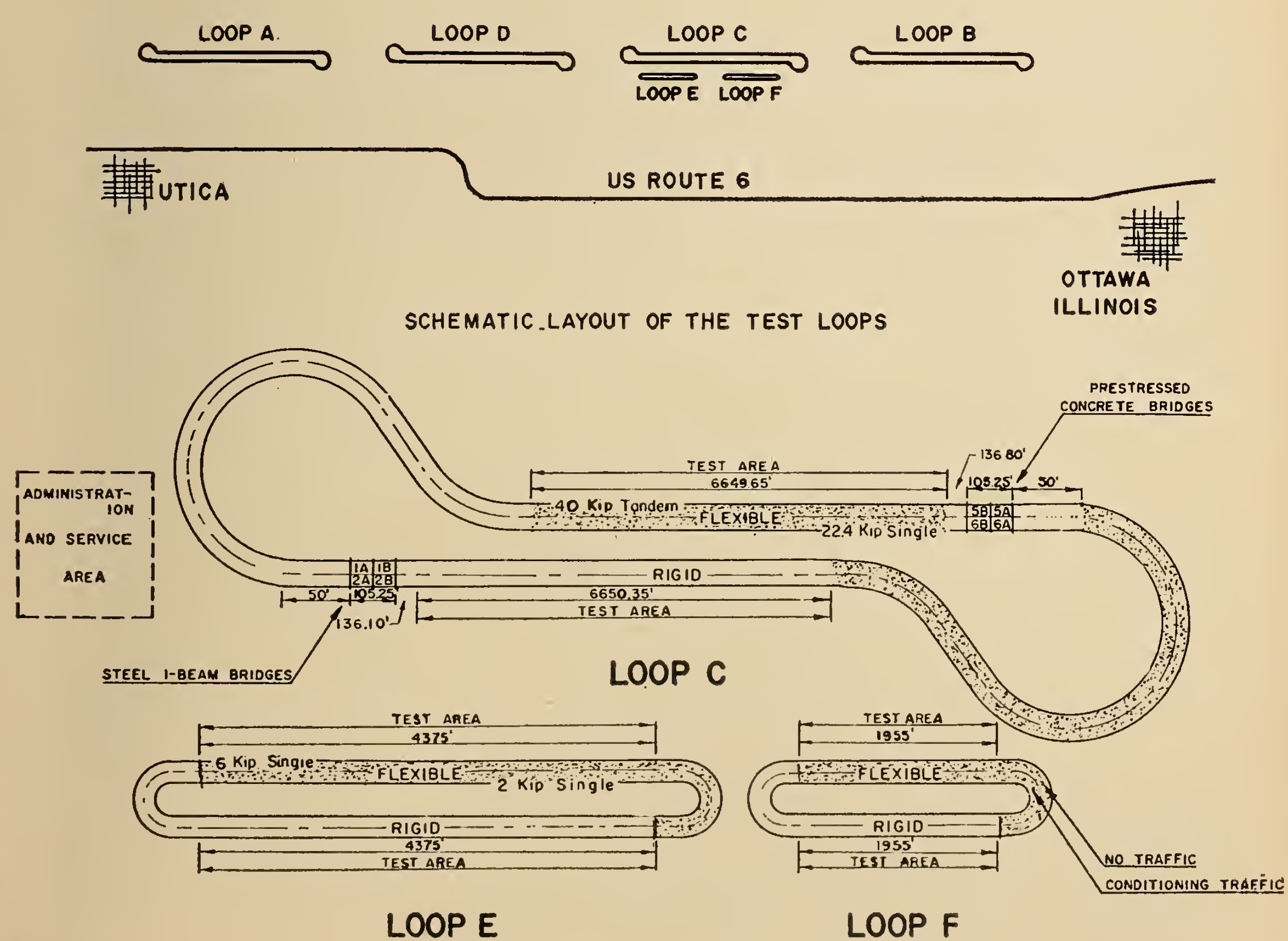
Apart from the bridge experiments, the AASHO project is primarily an evaluation of pavement performance. To compare pavements of different design, it is essential that the subgrade or basement soil be identical and in the same condition under all test sections. Therefore, the top three feet of the embankment for the entire test road was constructed with a highly uniform soil obtained from selected borrow pits. Furthermore, extreme care was taken during construction to

Fig. 1 and 2. Location of project, layout of test loops, and detail of flexible and rigid test areas.

APPENDIX I



LOCATION OF AASHO ROAD TEST PROJECT



control the placement and compaction of this material.

Despite these precautions, some variation in the subgrade condition may occur. So that such variations will not influence the correlations developed from this test, another important statistical tool was employed. The location of the loops and the location of each test section within any one loop tangent were randomized. The importance of the use of statistical methods, such as factorial designs and the randomization of tests, in any highway research investigation, no matter how small the project, cannot be overemphasized. The use of statistical design and analysis techniques will ensure that valid results are obtained with minimum cost and effort in any research undertaking. This is particularly important in a project of the magnitude of the AASHO Road Test.

Due to the complexity of the experimental design which in all contains 836 test sections, no attempt will be made here to describe its details. However, the scope of the undertaking can be realized by considering certain limits of the design variables. The 10 traffic lanes of loops A through E will each be subjected to a different axle load. These loads will range from 2,000 pounds on single axles to 48,000 pounds on tandem axles. In the rigid pavement experiment, the concrete slabs will be both reinforced and non-reinforced, and will range in thickness from 2½ inches to 12½ inches. Beneath these various slabs, sand sub-bases having depths of 0, 3, 6 or 9 inches will be used. The flexible pavement test sections will be composed of asphaltic concrete surfacing, crushed stone base course, and a sand sub-base. The surface will range in thickness from 0 to 6 inches, the base from 0 to 9 inches, and the sub-base from 0 to 16 inches. The total flexible pavement thicknesses will thus range from 0 to 31 inches. Special test sections have been included to evaluate the effect of bituminous concrete paved shoulders on the performance of both rigid and flexible pavements. Other special sections with cement treated base, bituminous treated base and gravel base have also been included in the experiment.

In addition to the pavement design studies, 16 single-lane, 50-foot-span bridges will be included in the investigation. These structures will be subjected to repeated applications of the four heaviest axle loadings used in the test, and will be loaded to destruction at the conclusion of the experiment. Eight of the bridges will be of steel I-beam design, four of prestressed concrete design, while the remaining four will be of conventional reinforced concrete design.

Measurements and Instrumentation

Two main classes of measurements will be made in the test. First are the pavement behaviour characteristics including surface roughness, cracking, and faulting of joints. These will be used to evaluate the relationship between the behaviour of the different pavement sections, and the loads that operate on them. The second type of measurements will be designed to determine why any particular pavement section failed, and in what way it failed. These measurements will include moisture contents, temperatures, deflections, stresses, and strains.

Some of the instruments to measure the indicated variables are already available. These would include thermo-couples and strain gauges. However, no device is available with which subsurface soil moisture contents can be measured in a non-destructive test with a sufficient degree of accuracy. A new device to accomplish this is currently under study by the project staff. Although the insrument shows promise, it may be necessary to resort to destructive tests in which samples are taken through the pavement, if the device does not prove satisfactory.

The project staff is also working on the development of an accelero-

Fig. 3. Chart defining the rigid test pavements to be included in the AASHO study.

Experiment Design – Rigid Pavement

Loop	Traffic	Subbase Thickness / Reinforcing / Surface Thickness	2.5		3.5		5.0		6.5		8.0		9.5		11.0		12.5		Sections	
			R	N	R	N	R	N	R	N	R	N	R	N	R	N	R	N	per Lane	Test Footage
F	No traffic	0	⊗	X			X	⊗Ⓖ					⊗	X			X	⊗		
		3																		
		6	⊗	X			X	⊗Ⓖ					⊗	X			X	⊗		
		9																	28	1140
	Traffic for conditioning, deflections & strains	0	⊗	X			X	⊗Ⓖ					⊗	X			X	⊗		
		3																		
		6	⊗	X			X	⊗Ⓖ					⊗	X			X	⊗		
		9																	28	1140
E	2 kip single	0	X	X	X	X	X	X												
		3	X	X	⊠	X	X	⊠												
		6	X	X	X	X	X	X												
		9																	20	3600
	6 kip single	0	X	X	X	X	X	X												
		3	X	X	⊠	X	X	⊠												
		6	X	X	X	X	X	X												
		9																	20	3600
A	12 kip single	0				S̄S				S̄S										
		3			X	X	⊗	X	X	⊗	X	X								
		6			X	XS	X	⊗	⊗	XS	X	X								
		9			X	X	X	X	X	X	X	X							34	5760
	24 kip tandem	0				S̄S				S̄S										
		3			X	X	⊗	X	X	⊗	X	X								
		6			X	XS	X	⊗	⊗	XS	X	X								
		9			X	X	X	X	X	X	X	X							34	5760
B	18 kip single	0						S̄S				S̄S								
		3					X	X	⊗	X	X	⊗	X	X						
		6					X	XS	X	⊗	⊗	XS	X	X						
		9					X	X	X	X	X	X	X	X					34	5760
	32 kip tandem	0						S̄S				S̄S								
		3					X	X	⊗	X	X	⊗	X	X						
		6					X	XS	X	⊗	⊗	XS	X	X						
		9					X	X	X	X	X	X	X	X					34	5760
C	22.4 kip single	0								S̄S				S̄S						
		3							X	X	⊗	X	X	⊗	X	X				
		6							X	XS	X	⊗	⊗	XS	X	X				
		9							X	X	X	X	X	X	X	X			34	5760
	40 kip tandem	0								S̄S				S̄S						
		3							X	X	⊗	X	X	⊗	X	X				
		6							X	XS	X	⊗	⊗	XS	X	X				
		9							X	X	X	X	X	X	X	X			34	5760
D	30 kip single	0										S̄S				S̄S				
		3									X	X	⊗	X	X	⊗	X	X		
		6									X	XS	X	⊗	⊗	XS	X	X		
		9									X	X	X	X	X	X	X	X	34	5760
	48 kip tandem	0										S̄S				S̄S				
		3									X	X	⊗	X	X	⊗	X	X		
		6									X	XS	X	⊗	⊗	XS	X	X		
		9									X	X	X	X	X	X	X	X	34	5760
																		Totals	368	55,560

Legend:

X = One section in main factorial
⊗ = Replicate factorial section in tangent layout
⊠ = Replicate factorial section in acceleration lane
S̄ = Special study section – no paved shoulder
S = Special study section – 6' AC shoulder
G = Two sections for subsurface study

Section Length:

Reinforced section: 240' in Loop A, B, C, D, E
40' in Loop F
Non-reinforced section: 120' in Loop A, B, C, D, E
15' in Loop F
Subsurface study section in Loop F: 120'

Transitions Length:

Between construction blocks: 60' to 90'
Within blocks, between sections: 10' to 40'

AASHO TEST ROAD July 31, 1956, Revised Sept. 27, 1956

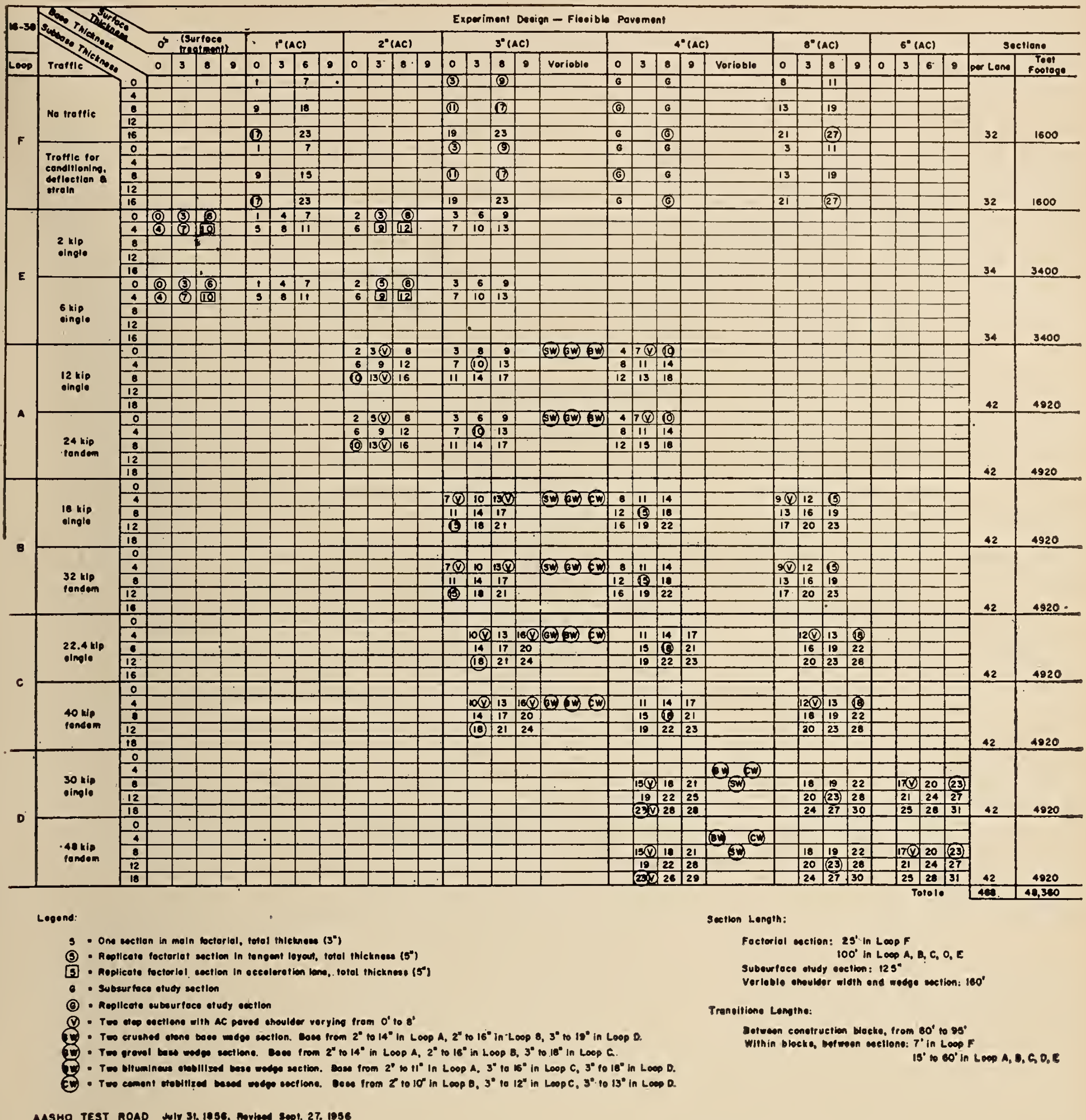


Fig. 4. Chart defining the flexible pavement test sections to be included in the AASHO test.

meter which could be installed in the pavement in order to measure dynamic pavement deflections under moving loads. This device would not require the installation of long reference rods under the pavement. Such rods partially invalidate the results of these tests by creating a serious discontinuity in the pavement structure. This was demonstrated in the WASHO test. Of course, other routine deflection measurements will be taken under slower moving loads by means of the Benkleman beam.

One of the most important measurements which will be taken in the road test will be longitudinal profiles. These, of course, are related to surface roughness and hence to riding quality. In general, riding quality determines whether a pavement is satisfactory or not. The project staff has been working on a device to record profiles quickly. If successful, this would ensure adequate coverage of all sections, and reduce test traffic delays to a minimum.

Wherever possible, instruments will be electronic rather than manually operated mechanical devices. This is almost essential if the many millions of necessary measurements are to be made during the brief two years of traffic testing. The multitudinous data from these instruments will be recorded either on IBM punch cards or digital tape. In this way, data analysis may be programmed for high speed electronic computers.

Test Road Program

After this description of the design, physical layout, and instrumentation of the AASHO road test, it would seem appropriate to mention the target dates for the completion of construction and testing as well as publication of the final report. Although the grading contract was only let in July 1956, the contractor was able to complete about 95 per cent of the subgrade construction (nearly 1½ million cubic yards of earth) before the job was closed down in November. This work will be completed in the spring. Paving contracts will be let in the spring and it is hoped that by late summer of 1957 the paving and test bridges will be complete. A permanent office and laboratory building was erected last fall. Other buildings, including a vehicle maintenance garage should be completed this summer. Hence, by the fall of 1957 traffic testing should commence. This will continue for about two years. As nearly a year will be required for data analysis and report writing after the completion of testing, the final results will probably not be available until some time in 1960.

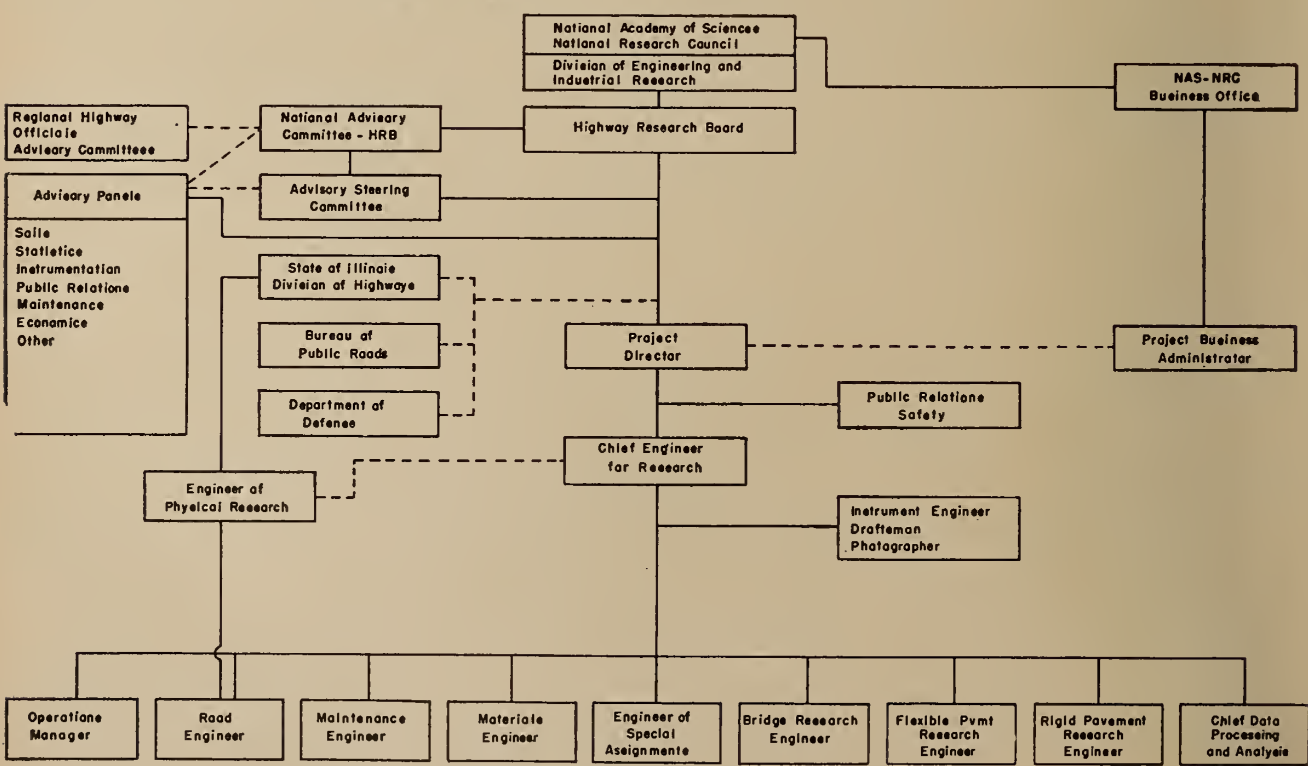
Significance of the AASHO Road Test

The AASHO project is designed to provide at least partial answers to many important questions of vital concern to all people interested in highways and highway transportation. Among these questions are the following: What is the relationship between single and tandem axle loads of various intensities? What are the relative pavement design requirements for various axle loadings? What are the relative supporting values of the various components of both flexible and rigid pavements? Would thicker bituminous surfaces, for example, provide a more economical flexible pavement design than the sections currently in common use today? To what extent, and in what way does reinforcing affect the behaviour of concrete pavements? What are the most suitable tests for pavement design and the evaluation of existing pavements? Will paved shoulders increase the load-carrying capacity of flexible or rigid pavements? Could maintenance practices be improved to prolong the life of existing pavements?

It would be entirely unrealistic and unwarranted to assume that the AASHO road test will provide all of the answers to all or any of the questions confronting highway technologists today. However, a substantial body of new and valid information should be obtained which, when combined with the results of other investigations, could produce information of very great importance. These companion investigations, which must be undertaken on a local or regional basis, are essential if full benefit is to be derived from this test. These supplementary studies, which are of equal importance to the road test itself, are necessary if we are to redefine legal load limits on an economic basis, or are to use the test road data for taxation studies. Such comprehensive studies of highway costs, vehicle operating costs, road and street use, and highway needs, are currently being conducted in the United States for the purposes indicated.

As I have said, the AASHO project is not the first major road test. Furthermore, it probably will not be the last. Many major problems will remain unsolved, and undoubtedly the results of this test will indicate significant variables which will require further research and investigation. However, for a period of years after the AASHO experiment is finished, the results of this test will be the only valid data available for use in any solution to many problems of pavement design, vehicle load limits, and road and street tax allocation. No matter how this test turns out, its results will greatly influence the thinking of all engineers, economists, and legislators. I am convinced that all highway engineers should be familiar with the design and conduct of these tests as well as the analysis of the results. Follow the articles which will appear in engineering publications from time to time. This is necessary if the data to be obtained are to be used intelligently and effectively in our efforts to create good roads.

Fig. 5. Organization of the AASHO road test project.



Evaluating Performance in an Engineering Department

H. L. Johnston, M.E.I.C.
Chief Engineer, Du Pont of Canada Limited

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Revised paper received 3 October 1957

The author gives a comparative appraisal of the various systems for rating employees and describes the procedure used in the engineering department of his own company. The paper was presented to several branches of the Institute and was received with considerable interest.

BEFORE "MOSES chose able men out of all Israel", after consultation with his father-in-law Jethro, "and made them heads over the people, rulers of thousands, rulers of hundreds, rulers of fifties and rulers of tens" he had to make some sort of evaluation of the capabilities of a large number of people. As time passed he undoubtedly found that some of his appointees meted out justice much more ably than others and referred fewer of the "hard causes" to him for adjudication. We suspect that he did not use a formal rating plan to help him distinguish between the better and the poorer administrators but at least he had a method of doing so even if it consisted only of making mental comparisons.

The same thing happens today. Every administrator has to rate those who respond to him in some fashion, call it by whatever name you will. According to "Studies in Personnel Policy No. 121" by the National Industrial Conference Board about forty per cent of companies have formal rating systems. While some companies are discontinuing the use of rating plans, others are starting to use them. Some organizations that use formal plans say they could scarcely operate without them whereas some of the nearly sixty per cent of companies that do not use them say they are unnecessary, undesirable and full of potential danger. Thus, there is wide disagreement about the desirability of rating employees by formal systems.

There is also great divergence of opinion among those companies that have rating plans about the type of plan to use; and furthermore, for any one type opinions differ about how complex or how simple it should be. Sponsors of the different plans have very strong opinions about them. These varying and resolute opinions stem to some extent from the varying forms of organization that have used particular plans and from the success or lack of success they have had with them.

In selecting the type of rating plan to use or whether or not to use a formal plan one can not be guided with certainty by those whom Prime Minister Louis St. Laurent called "successive generations of thoughtful men". These thoughtful men seem not to have arrived at a unanimous conclusion. One also has to recognize that some of those who have developed rating plans started them because they were fashionable. Some of the fashion followers are probably among those who have discontinued formal rating, as their motives were not well founded.

With these preliminary remarks as a background I should like now to discuss the reasons for rating employees, the various types of rating plans, the arguments for and against each and the type that I use in assessing performance in an engineering department.

I have called this talk "Evaluating Performance". It could be said that I have needlessly introduced another expression but in defence I plead that I have done so in order to include under one heading many of the names given to rating or performance review procedures, such as Employee Rating, Merit Rating, Performance Reviews, Performance Appraisals, Progress Reports, Employee Evaluation Reports, Service Reviews and many others.

From a supervisor's point of view the most useful rating procedure is the one that will give him, without wasted effort, the information about his subordinates that he has to have to do his job efficiently.

I do not think that many organizations have established rating plans because it is a noble or splendid thing to do. I do think, however, that many plans do not yield a return commensurate with the effort expended on them and that there is such a thing as a law of diminishing returns.

The first thing to decide in setting up a rating plan is what you want it to do for you. Some of the reasons given for having rating plans are:

(1) To help sort out the better from the poorer performers.

(2) To assist in selecting employees for promotion, retention or lay off.

(3) To aid in determining equitable salary differentials.

(4) To form the basis for letting an employee know where he stands.

(5) To point up training needs.

(6) To make sure that every supervisor takes time to think about every one of his subordinates.

Having determined what you want from a rating plan or procedure your next move is to select a suitable one. If you can't find one that will fulfil your requirements you may with a little thought develop one of your own. It will probably fall within the following types of plan or be a combination of more than one type.

(1) Graphic rating scale. For each trait or characteristic the rater is required to mark on a bar, representing 0% to 100%, his assessment of the employee.

(2) Chart system. The rater, for each trait, puts a check mark in one of several blocks indicating whether the employee is average or above or below average. Sometimes the blocks or spaces above and below average (or standard) are headed average plus, high, average minus, and low; and sometimes they are headed by descriptive phrases.

(3) Check list with descriptive phrases. The rater is usually required to check Yes or No for each trait.

(4) Forced choice. In each of many blocks of four to six unrelated job performance statements the rater has to indicate the statement that is most descriptive of the employee and the statement that is least descriptive.

(5) Field review. The rater is a specialist, probably from the personnel department, who discusses with a supervisor the traits and performance of each of his subordinates. Later the specialist discusses his completed ratings with the supervisor who signs each rating sheet after it has been revised to suit him.

(6) Critical incident. A supervisor lists for each of his employees incidents, as they occur, that reflect favourable or unfavourable performance. He uses the lists later to complete the ratings of his subordinates.

(7) Self rating. The employee is asked to make a sincere appraisal of his own performance.

(8) Freely written paragraph. A supervisor is required to write a concise paragraph describing the performance of each of his subordinates.

(9) Forced written paragraph. The supervisor is required to comment on particular phases of each person's performance.

(10) Rank order. All persons in a classification are listed in order from best to poorest for each characteristic and assigned consecutive numbers commencing with number one. The ranking numbers for each person for all characteristics may be added. The person with the lowest total ranks first.

(11) Paired comparison. The supervisor compares each person in a particular classification with every other person and ranks him 1 or 2 for each trait or characteristic. The person with the lowest total rating ranks first.

(12) Forced distribution. Employees in a classification are distributed into designated percentage groups from poorest to best. Ten per cent must be designated as the poorest performers and ten per cent as the best.

Most of the twelve better known plans or systems that I have just listed have been used for rating persons at all levels of responsibility. The traits or characteristics on which persons are judged in many of the systems have to be changed for groups having widely different degrees of responsibility. Plans that are used for rating hourly paid employees may be unsuitable for rating salaried employees who occupy senior supervisory positions. Much formal rating of hourly paid persons has been discontinued as unions object not only to unilateral ratings but to any procedure that will point up differences between employees in a particular classification. All rating plans are designed to point up differences. Management wants to know these differences in order to utilize its employees in the most effective manner and in order to reward them equitably.

There is, of course, also a wide difference in responsibility among salaried employees, all the way from the office boy up. Some companies use forms for rating persons in the more responsible positions that differ from the forms used for rating persons in the more junior positions. Unless this is done, under some systems many meaningless entries may be made in rating all of the employees in the organization.

The graphic scale method and the chart method (a variation of the graphic scale) are the most commonly used. The degree of perfection has to be indicated opposite each characteristic whether or not it has a major influence on performance. The employee is pulled apart piece by piece not always by persons fully qualified to do so. The overall performance is often judged by a summation of the pieces which may not give the correct or best answer. A salesman who brings in business amounting to half a million dollars a year is doing better than the one whose orders total two hundred thousand dollars. The totals of the bits and pieces on the chart may not give the nod to the better performer. He may show up to be the poorer in the majority of the characteristics but the form does not give his outstanding trait that brings in the orders any more weight than is given to less important characteristics. The graphic scale and chart methods do reveal where training may be used to improve performance and they do make a supervisor think about the parts that go together to make the whole man.

The tendency now is to reduce the number of characteristics or traits listed on the forms used in the graphic scale and chart systems and to rate job performance rather than personal traits. Some analysts advocate limiting the number of characteristics to between six and ten and some to not more than three. They think that the less detail asked for the less tedious will be the job of sorting out the significant elements and the more useful the tool will be.

Check lists like many other systems have the virtue of making a supervisor think of each subordinate from different points of view. They tend to be cut and dried in their approach and therefore beget mechanical answers.

The forced choice system was developed by the United States Army and used by it during World War II and by some industrial organizations. Specialists are required to correlate the answers to the unrelated statements. The system is designed to make the ratings more objective. The supervisor who answers the questions about his employees has to wait for someone else to tell him the result.

It takes a long time to rate large groups using the field review system. The personnel department does most of the work and that is a good or bad thing depending on your convictions.

The critical incident system has the virtue of dealing with observed performance. It is a bit like some of the employee counselling systems that were set up during World War II. One had to watch that entries recorded were not all critical of the employee. I can remember a union deriding attempts at counselling and calling the notes that were kept "little black books". Incidents really should be discussed when they occur and not some weeks or months later.

It is reported that where self rating has been tried the rater is frequently more critical of himself than his supervisor would have been but this is not always the case. The ratings can be used only as a basis for counselling or discussing performance, preferably by one skilled in the art.

The freely written paragraph has the advantage of being simple. The rater deals with the whole man and intuitively probably gives him a truer overall rating than could be done by adding the pieces. The "halo" effect (a single outstanding characteristic dominating the rater's judgment) undoubtedly plays its part but it can quite well be a proper part. Paragraphs written by different raters will certainly lack uniformity.

The forced written paragraph gives uniformity to the paragraphs by requiring comments on specific phases of each man's performance. Comparison of one employee with another based on these specific phases may be made more readily than with the freely written paragraph.

For a single characteristic probably no system is better than the rank order system for comparing employees doing the same type of work in a particular group. Comparisons between persons in different groups are not easy unless reliable reference points can be established. Overall ratings are not too reliable if obtained by assigning numbers for each characteristic and adding the numbers to determine the overall rank order as it cannot be assumed that the different characteristics carry equal weight.

The paired comparison system is a variation of the method of arriving at rank order rating. Whether it is worthwhile is purely a matter of opinion.

The forced distribution system is something like the rank order system. Its sole advantage is that some people find it easier to divide people into a limited number of groups than to list them in order of merit.

I have used a few of these rating systems or techniques in the past and have not been satisfied with any of them whether rating hourly paid employees or staff employees. At the present time I use a combination of a few of them and do so because the combination which I call a comparative performance review gives me in a large measure the results that I want with a minimum of effort by all levels of supervision. The end result is the important thing and not the system. No supervisor has to rate his men on a particular form or on any form to find out which is his best man and which is his poorest. The form can be of assistance to him however in recording the performance of an employee in such a way that it can be compared readily with the performances of others in the same group and in other groups.

The things that I want from a performance review are:

(1) A concise paragraph written by the immediate supervisor describing the man's overall performance, his outstanding strong points, if any, and his outstanding weaknesses, if any. If the paragraph has more than eight lines it is too long and if it is shorter than two lines it is too short.

(2) The rank order of the employee in his classification in the immediate supervisor's jurisdiction. This rank order is to be determined from an assessment of the employee's immediate worth to the supervisor. If the supervisor had to drop one man from the classification the one that he could spare easiest would rank the lowest.

(3) The immediate supervisor's assessment of the overall performance of the employee compared with the performances of all others across the country in a similar classification and having a like amount of experience. This assessment may be recorded as "Top 10%" or "Top 10 to 25%", etc.

A supervisor should talk to his subordinates on the job daily, weekly, and monthly about their work. He should not fail to tell them when a job has been done well . . . and how a job could be done better.

The entire record by the immediate supervisor should occupy no more than half of an 8½ x 11-in. sheet of paper. He may use a plain sheet but it saves him a little writing to have one headed "Comparative Performance Review" and to have items 2 and 3 headed so that all he has to do is to record numbers.

That is all, except for the all important reviews by succeeding levels of supervision which are to be recorded on the remainder of the sheet. The supervisor next in line (supervisor B) holds a meeting with all of the supervisors who respond to him (referred to above as "immediate supervisor") and now designated as "supervisors A". The "supervisors A" question one another about the ratings already recorded. One may say to another: "I had Joe and Harry working for me last year and unless Harry's performance has fallen off he is a better man than Joe". Thus, "supervisors A" criticize one another's ratings and of course "supervisor B" contributes his observations. Having agreed on one another's ratings a comparative rating for each classification in "supervisor B's" group is made by discussing the relative merits of all of the employees. "Supervisor B" then records on each sheet the agreed ratings for items 2 and 3 in his jurisdiction and records any modification he cares to record of item 1, the concise paragraph. So also for succeeding supervisors including the chief engineer. Thus a comparative rating of employees in every classification is arrived at through pooled judgment.

The system works equally well for rating draughtsmen, clerks, stenographers, and engineers and any other classification of employees in an engineering department or for that matter in any other department.

The results may be readily tabulated and used for various purposes including the administration of equitable salaries. The sheets are not typed but are filed, just as prepared, in the employees' personal files where any supervisor may examine at any time the rating sheet for any employee who responds to him.

The first item on the comparative performance review sheet is a freely written paragraph, the second a rank order rating and the third a group rank order rating. (See page 84.)

When meeting with those who respond to me to agree on final comparative ratings I find it convenient to have sheets prepared ahead of time that list employees in each classification in the order of their experience. (Listing people alphabetically tells you nothing about them.) The sheets have columns for recording comparative ratings and performances. By the time we finish discussing the performances of the last group of employees to be considered we each have before us in convenient form comparative ratings for all employees in the department. I know how each employee compares with others in his classification and frequently with those in other classifications. I also know how each one's performance compares with the performances of others across the country having a like amount of experience and doing comparable work. Later, I again review in detail the written comments on each person's performance, make notes on matters that require attention and sign the sheets before they are filed.

Until now I have said nothing about post appraisal interviews. Some rating systems appear to be directed straight towards post appraisal interviews as if these interviews were the ultimate goal of all management effort. That presumably was not the intention of those who developed the systems but some few supervisors have felt it incumbent on themselves to live up to the supposed intent and to embark on a campaign of telling each employee just what is wrong with him. These campaigns include dissertations on the philosophy of behaviour and include exposing the detailed rating sheets to the view of employees and a blow by blow recitation of the ratings. An employee who has a good rating throughout may be somewhat relieved but at the same time wonder how he would have felt had his judgment or intelligence or some other characteristic been rated as poor. An employee who receives a poor rating on some traits feels resentful, but if he is wise he recognizes his position as a captive audience. If he argues about the justification of a rating, next year, opposite the proper description he will find that he is labelled "Does not take criticism well".

The write-ups of post appraisal interviews are sometimes used to judge the ability of the interviewer. Recognizing this the occasional supervisor puts his best foot forward and puts on record an exaggeration of the interview which will put him in a good light. Such practices are occasionally exposed when a transferred employee is reminded of something that was said to him by an earlier interviewer.

I have not made these comments to discredit post appraisal interviews but rather to try to put the whole matter of rating and interviews in proper perspective. I do not think that an elaborate rating form or any rating form need be made out before a supervisor talks to one of his employees about his performance. He should talk to his subordinates on the job daily, weekly, and monthly about their work. He should not fail to tell them when a job has been done well and should not fail to tell them how a job another time could be done better. He should lead them and train them and strive for their interest and co-operation by giving them responsibility. He must avoid tactless criticism of personal traits. It is dangerous to talk to an individual about his traits. You can however talk to him about performance and should do so at opportune times which may be as incidents arise or when letting him know of an increase in his salary or after making an appraisal of his performance. The supervisor, knowing the conditions, must be the sole judge of when to interview an employee and of what to discuss with him. There are of course occasions when a supervisor should talk to an employee about some characteristic that if not improved will retard his progress but the supervisor himself has to determine the opportune time and the probable effect.

Much has been said in the past about how to carry out post appraisal interviews. Certain techniques were developed some of which at times became ludicrous as a supervisor would find that the stereotyped techniques that he used were in turn used on him. Interviewers slavishly followed instructions on how to put a man at ease at the start of an interview. At no other time did a supervisor stand up and greet his subordinate when he came to his office, ask him to sit down and be comfortable, offer him a cigarette and ask him about his family. The whole interview was wrecked if the subordinate said he wanted to stand up, did not want a cigarette and had no family. This reminds me of an interview I once had with a man who had one degree, was about to receive another in engineering, and then proposed to study for a Ph.D. specializing in mathematics. He told me that he knew that he was more intelligent than other students as he always led the class and always expected to get 100% in examinations. He said that he spent all of the time that he was awake studying or solving interesting problems and did not have time to play games or go to dances and meetings. I felt very wise and ventured to suggest that associating with others at a university was part of one's education. It taught one how to get along with people and how to become a leader. I suggested that if he were some day going to be the president of a company he would at some time have to learn how to associate with and handle people. He replied that he had no desire to become the president of any company or a manager or supervisor. His sole ambition was to be a mathematician and to spend his time solving problems. He had no ambition to make a lot of money. He merely wanted to have work that interested him.

More power to him! We need more such people with singleness of purpose. He will function in a realm unknown to most of us. He will be the brains behind the design and use of the electronic computers of the future and of other devices not yet invented. There is a lesson to be learned from my encounter with him. Why should I attempt to mould him into a standard article? Who am I to set myself up as accuser and judge of his personal habits and traits? Don't I realize that he might resent my intrusion into his personal life? Might he become disturbed and frustrated and instead of becoming a genius end up like the rest of us?

To get back to the subject of this talk I should like to compare briefly the comparative performance review that I use in assessing performance with the so-called chart system having three or four legal size pages of spaces to fill in and comments to make. The advantages of the procedure used in our Engineering Department are:

(1) The review is simple and all on one small page.

(2) It is not typed as only one copy is required, thus keeping cost to a minimum.

(3) A complete review of over 250 employees can be done within two weeks instead of up to three months.

(4) Comparative information is readily available for determining salary differentials.

(5) Other comparative information is readily available for considering promotions, transfers and dismissals.

(6) Salient strengths and weaknesses stand out for consideration in undertaking training or an interview.

(7) Supervisors are encouraged to discuss performance on the job and at the time of a salary increase interview. A written record of the latter interview is put in the employee's file. Supervisors are also encouraged to file a record of any significant interview carried out at any time.

I do want to say a word about training because training courses can be used to discuss objectively traits or characteristics that would cause resentment if discussed subjectively in a private interview. In a training course unsatisfactory traits may be discussed in a two-fisted manner and sometimes a knock out blow can be administered that will have a salutary effect. A training course is also a good place to tell all employees about the rating procedure and what it is used for. It is revealing to observe the satisfaction that is expressed by persons on training courses when they hear that their performances are judged not by one person but by a group.

Comments on Forms of Ratings

I carried out a minor survey not long ago among persons who had had experience with the two types of rating that I have been talking about. Some of them are in supervisory positions and some not. Here are some of the comments.

(*a*) "I went a long time under different supervisors before anyone said anything about my performance. Interviews are worth while".

(*b*) "Anyone who discussed my performance did so when I was told about an increase in salary. As a supervisor I found the forms tedious to work with and not too effective in assessing a man's real worth. Performance should be discussed at a salary increase interview and at other appropriate times".

(*c*) "The trait type of form is educational for a person new to a supervisory position as it reminds him of traits that he might not think of. As he gains experience he does not need a list and may be better without one. A compulsory type of performance interview has its drawbacks particularly if there is little to say. I knew of a supervisor who tossed a cigarette to a subordinate whom he had previously interviewed several times and said 'Here is your cigarette Joe. We're back at it again'."

(*d*) "I was unfavourably impressed by a supervisor who read off from a rating form the ratings he had given me saying you are above average in this and not quite average in this. I felt like arguing with him, thought that some of the ratings were unreasonable and felt at a disadvantage as he had obviously got prepared for the interview. I feel that at intervals of a few months and when various assignments are being completed it would be stimulating to hear from your supervisor comments about your performance, that is, whether you had done a good job or whether some improvement could have been made".

(*e*) "I have never seen a rating form but heard that performance reviews were made. I have had my performance discussed with me on the job and when told of increases in my salary. I think these were proper times. I have been under different supervisors. If I rated them their ratings would be wide apart. I would hate to put some of the ratings on paper as I would not know what to do with them".

(*f*) "I once thought that the idea of a multi-factor rating form was quite noble but found later that it fails to give an easily understood assessment of individuals in a group. I have been told at the time of an increase in my salary that I was doing good work. I think that performance should be discussed more frequently while work is in progress".

(*g*) "I have disliked the analytical approach to interviews and have felt that the forms that were used for rating had far too many details. A man can take criticism much easier at the time he is told of an increase in his salary. At that time he does not feel that he is on the spot. If the same criticism of a personal trait is repeated the employee will probably become particularly resentful and may develop an inferiority complex. I know of a case where a performance review form was followed step by step by a supervisor in carrying out an interview. This created a most unfavourable impression on the employee".

(*h*) "I find that our present method of comparing employees helps me greatly in my day to day work. With a large number of employees I do not know what I would do without it. I was never able to get much help from the detailed sheets we used to use. I hope we don't go back to them".

(*i*) "I have had my performance discussed with me informally on a few occasions when I asked how I was doing and what I could do better. Also in the past one supervisor read out to me the answers he had recorded on a form on which I had been rated. There were many of them and it all seemed sort of senseless".

Comparative Performance Reviews

Let me now quote from some of the comparative performance reviews made in July 1956 of a hundred and thirteen draughtsmen. These are in their final rank order. You will note that the freely written paragraphs give a good idea of the change in performance as the rank order changes; that the rank order indicates an employee's immediate relative worth to the Company; and that the position-experience-performance rating directs attention to the best and poorest performers in all experience groups and helps in determining salary levels and differentials. I have substituted numbers for actual names in the following extracts from our files and, except for the first example, have omitted the ratings by intermediate supervisors. Similar reviews are made for engineers at all levels in the Engineering Department as well as for clerks and stenographers.

(1) *Draughtsman Grade IV.* Experience 28 years. He has a sound mechanical background, broad experience in machine design and is the key man in his squad. He has on occasions satisfactorily replaced his squad leader.

Rank order in immediate supervisor's jurisdiction: 1st of 2 Grade IV draughtsmen; 1st of 14 in the squad. Position - experience - performance rating: Top 25% to 50%.

Rank order in Chief Draughtsman's jurisdiction with 12 squad leaders: 4th of 20 Grade IV draughtsmen; 4th of 113 draughtsmen.

Position - experience - performance rat-

ing: Top 25 to 50%. He consistently does good work.
Review by Chief Engineer, 1 Supervising Engineer and Chief Draughtsman: As above except position-experience-performance rating changed to Top 10 to 25%.
(Note: If engineers were being rated, 5 supervising engineers and the Chief Engineer would form the final appraisal group.)

(2.) *Draughtsman Grade IV.* Experience 35 years. He is a conscientious worker with good design ability and excellent basic technical training. He can do a variety of work and is reasonably fast and neat. He would be more valuable if he had more self-confidence and did not depend so much on others.
19th of 113 draughtsmen.
Position - experience - performance rating: Top 25 to 50%.

(3) *Draughtsman Grade II.* Experience 7 years. He has been with the Company only a short while but has made a good impression. He has design ability and is a keen, aggressive worker. He has completed all but one year of an engineering course at a university.
28th of 113 draughtsmen.
Position - experience - performance rating: Top 10%.

(4) *Draughtsman Grade II.* Experience 8 years. He is a technical school graduate and shows excellent promise for arrangement and process work. He can work on his own and has shown initiative.
37th of 113 draughtsmen.
Position - experience - performance rating: Top 10 to 25%.

(5) *Draughtsman Grade III.* Experience 33 years. He is a neat draughtsman but a bit slow. He requires close supervision.
77th of 113 draughtsmen.
Position - experience - performance rating: Top 50 to 75%.

(6) *Draughtsman Grade II* Experience 7 years. He has been trained as a machinist but has changed to draughting. He has little draughting experience and is careless. At the moment his ability and future value are in doubt.
112th of 113 draughtsmen.
Position - experience - performance rating: Top 75 to 90%.

Conclusion

I have described to you a procedure for rating employees that is peculiar to the Engineering Department of Du Pont of Canada. With a minimum of effort it seems to give us most of what we need to know to sort out the better from the poorer performers; to make proper selections for promotion, retention and lay-off; to determine equitable salary differentials; to discuss performance with an employee; and to determine training needs. Not only must every supervisor take time to appraise every one of his subordinates at regular intervals but he must justify his appraisal before a group of other supervisors. Like most other works of man the procedure has its limitations and for optimum results is dependent on the efforts put forth by those who use it. It is one way of evaluating performance. Your way could quite well be a better way for your particular conditions.

Acknowledgments

Holy Bible, Exodus, Ch. 18, vv. 25 and 26.

"Employee Rating", Studies in Personnel Policy No. 39, National Industrial Conference Board.

"Appraisal of Job Performance", Studies in Personnel Policy No. 121, National Industrial Conference Board.

"Supervision of Scientific and Engineering Personnel", by John T. Lloyd and Robert D. Gray, Bulletin No. 26, California Institute of Technology.

"Measuring the Performance of Engineers and Scientists", R. A. Kinckiner, *Chemical Engineering Progress,* April 1956.

"The 'Achilles Heel' of Management Development", Walter J. Mahler and Guyot Frazier, *Personnel,* March 1955, American Management Association.

"Appraising the Performance of Management Personnel", M. S. Kellog, *Personnel,* March 1955, American Management Association.

"Getting Better Results from Post Appraisal Interviews", Spencer J. Hayden, *Personnel,* May 1955, American Management Association.

"The Human Side", National Foremen's Institute, Nos. 215 and 217,

Engineering Department

COMPARATIVE PERFORMANCE REVIEW

Date: *10th June,* 1955 (*Fictitious*)

NAME *John Doe* Experience *7* years Position *Design Engineer*

PERFORMANCE

He is co-operative and possesses initiative, drive and a strong desire to do a good job. He tends to become involved in details although he tries (not always successfully) to meet schedules. He has limited experience on the type of design on which he is now employed.

A. IMMEDIATE SUPERVISOR'S JURISDICTION

Rank Order *Design Engineers* *3* out of *3*
___ out of ___
Position — Experience — Performance Rating Top *25%* to *50%*
Signature *A. B. Brown.*

B. NEXT SUPERVISOR'S JURISDICTION WITH *3* "A" SUPERVISORS

Rank Order *Design Engineers* *5* out of *8*
___ out of ___
Position — Experience — Performance Rating Top *25%* to *50%*
Comments *Potentially he is a very good man. He has been with us for only a year.*
Signature *D. E. Ford.*

C. NEXT SUPERVISOR'S JURISDICTION WITH *3* "B" SUPERVISORS

Rank Order *Design Engineers* *10* out of *16*
___ out of ___
Position — Experience — Performance Rating Top *50%* to *75%*
Comments *His scheduling and handling of details have been discussed with him. As he gains experience in our type of work his performance will undoubtedly improve.*
Signature *G. H. Abel.*

D. CHIEF ENGINEER WITH *5* "C" SUPERVISORS

Rank Order *Design Engineers* *24* out of *38*
___ out of ___
Position — Experience — Performance Rating Top *25%* to *50%* *Minus*
Signature *H. Lloyd Johnston.*

ABSTRACTS

BASED ON CURRENT LITERATURE AND EVENTS

APPLICATION OF GAMMA RADIOGRAPHY TO CONCRETE

J. A. Forrester, *The Engineer*, v. 205, no. 5327, Feb. 25, 1958.

The scope of industrial radiography has widened immensely in the past few years. This is due in part to the increased availability of inexpensive γ-ray sources, products of the atomic energy programme. Radiography is now being applied to an increasing extent in the production of metal castings and to the inspection of welds; but, in the field of cement products, very little use has been made of this non-destructive method of testing. The use of X-ray equipment is at a disadvantage because of high initial cost and immobility. Five γ-ray sources are commercially available for industrial radiography: cobalt-60, tantalum-182, iridium-192, thulium-170, and caesium-137. The sources are supplied as right cylinders of 2 mm., 4 mm., and 6 mm. diameter. A small aluminum alloy capsule encases the source and shields any β radiation. The main advantages compared with X-ray sets, are their small bulk, mobility, and relatively low cost.

All materials will attentuate γ-rays by an amount almost proportional to their density and thickness. The absorption co-efficient is a characteristic property of an element arising from two principal interactions of γ-rays with its atoms. In one form of interaction the rays give up all their energy to an orbital electron which is expelled. This is called the photo-electric effect. The other form of interaction called the Compton scattering effect occurs when the γ-ray photons impinge on the peripheral electrons of the atom and undergo energy losses in becoming transformed to photons of greater wavelength. These latter photons are scattered at an angle to the path of the original γ-rays. In the interaction of γ-rays of the energies generated by a cobalt-60 source with elements such as those comprising concrete the Compton effect predominates.

Assuming that the absorption by steel and concrete of γ-rays is in proportion to their respective densities, then the intensity of radiation which emerges from a 6 in. reinforced concrete slab, and which has passed transversely through an embedded ⅝ in. diameter steel bar, can be shown to be only 16 per cent of that emerging when the rays pass solely through 6 in. of concrete. Lead intensifying screens of 0.01 in. thickness placed in front of and behind the film during exposure to cobalt-60 rays will nearly double the effect of the rays. Cobalt-60 sources of the strengths which can be readily obtained will penetrate up to 18 in. of concrete and will define the presence of steel, but, due to hardness of radiation, will not show up differences in texture so well as the lower energy sources. The same applies to tantalum-182 which has the added disadvantage of a short half-life. Caesium-137 and iridium-192 have the right energy range and manageable sources can penetrate up to 10 in. of concrete. However iridium has a short half-life and caesium is expensive.

Cobalt-60 was the source used in the series of tests described. Concrete specimens suspected of being honey-combed or cracked were obtained and radiographed. Their condition was subsequently confirmed by breaking open the specimens. For example a piece of spun pipe which had an abnormal permeability to water was considered to be cracked below a coating of bitumen. The outside of the pipe was crazed and no definite crack could be seen from either side. The radiograph clearly showed a crack normal to the surface and travelling in from the edge of the specimen. Honey-combing in concrete is distinguishable as white patches in the radiograph. Movements of aggregate before and after vibration were made using pieces of artificial aggregate made from wood and lead. The location of reinforcing bars, the examination for severe pitting of the steel, and the checking of the grouting around prestressed wires can be effectively carried out by radiography.

As the prefabricated concrete member becomes more valuable there will be greater demand for it to be tested in a non-destructive way, and inspection by γ-radiography may be as important in concrete technology as it is in foundries and heavy fabricating shops.

SWEDEN TO USE NUCLEAR POWER FOR DISTRICT HEATING

John Grindrod, *Combustion*, v. 12, no. 118, March, 1958.

Sweden is decidedly lacking in indigenous sources of coal, oil and natural gas, and has to import carbonaceous fuels to cover more than 70 per cent of the total energy consumption, and a considerable part of this is used for space heating. Therefore there is great interest in the use of nuclear energy for district heating purposes. According to present plans, six reactors for central district heating will be erected within the next 10 years, the first two of which, one for Stockholm and one for Vasteras, are scheduled to be in operation by 1960.

The country's total possible production of water power is estimated at 80,000 m. kwh/year and present production is about 24,000 m. kwh/year. With the present rate of increase of electricity consumption it is estimated that Sweden will be able to continue to increase electricity generation from her water power resources for the next 20 years, but not much longer.

In 1945 the Swedish government appointed an Atomic Energy Committee to follow developments in the nuclear field. It now works as a research council supporting different kinds of fundamental research at universities and other institutions. A special organization, the Atomic Energy Company, was formed as a joint establishment between the government and private industry. The state owns four-sevenths and private industrial interests three-sevenths of the share capital. About 70 larger enterprises form the private shareholders.

During the last two years this company has begun to design industrial reactors based on the use of natural uranium and heavy water. Sweden has large deposits of uranium-bearing oil shales, but since this raw material is very low-grade, making the price of uranium comparatively high, the system of natural uranium and heavy water which requires limited quantities of uranium, seems especially attractive.

The first reactor R 3a with a 76 Mw. heat output for district heating is sufficient for a town of 30,000 inhabitants. Since a temperature of only slightly above 100°C. is required for heating water, the problems are less severe than for a power generating reactor. The reactor is so designed, however, that it can also be used later for the production of 14 Mw. of electricity by back pressure turbines. This later version is called the R 3b and if the problem of the production of fuel elements of sintered uranium oxide canned with zircaloy is solved in time the company will likely proceed with its construction directly. It will be built in collaboration with the city of Stockholm for the suburb Farsta, south of the city, and will be housed in an underground building.

This reactor is expected to provide valuable information for subsequent projects, e.g., for steam producing reactors for the pulp and paper industry, and on a reactor R 4, which is a power reactor for about 100 Mw. of electricity, also based on natural uranium and heavy water.

The present capacity of the Swedish Shale Oil Co. is only about five tons of uranium a year but it will shortly be doubled and then estimated at 20 metric tons/year in 1960, 75 metric tons/year in 1965, and roughly 200 in 1970. A new uranium plant for 100 tons/year is projected and is expected to be in operation in the early 1960s.

WIND POWER: BRITISH MACHINE IN ALGERIA

Engineering, v. 185, no. 4800, March 7, 1958.

The 100 kw. Enfield-Andreau experimental wind-driven generating plant built in 1950 for the British Electricity Authority has been under test in Algeria. Previous tests at St. Albans in the U.K. were not satisfactory due to poor wind conditions. In some 60 hours of running over a two-year period the maximum power developed was 25 kw. at 98 propeller r.p.m. with a measured depression of 16½ in. water.

The site in Algeria is 7 miles from Algiers and 850 ft. above sea-level. In November 1957 within the first seconds of operation the output rose to 130 kw. The machine has been turned over to the Algerian authorities who plan a 5 year test programme covering detailed performance measurements, including vibrational checks on the tower and the propellers to prove design assumptions.

The alternator works on the depression principle developed in France by the late M. Andreau. The blades of the wind-driven variable-pitch propeller are hollow, and as they rotate air is discharged through tip outlets by centrifugal force. The depression thus generated causes air to be drawn up into the blades, through an air turbine, near the base of the tower, which drives the alternator. There is no mechanical connection between alternator and propeller. The latter operates at a constant speed of 100 r.p.m. at wind speeds above 30 m.p.h., giving a constant volume of air flowing through the turbine (58,500 c.f.m.) The electrical output is held constant at 100 kw. between wind speeds of 30 and 65 m.p.h. Below wind speeds of 30 m.p.h. the propeller operates at constant pitch and the output of the turbine falls rapidly as speed decreases.

In the original design there was a free-wheel arrangement between the air turbine and alternator: the turbine ran free until a speed of 1,000 r.p.m. was attained when it locked with the alternator shaft. When the machine was re-erected in Algeria the free wheel was eliminated, the turbine rotor being coupled solidly to the alternator, which assists in stabilizing the alternator at synchronous speed during starting when the alternator is motoring.

It is hoped that devices such as this can be successful in supplementing hydro-electric power in the country.

REFUSE COMPOSTING PLANT

The Overseas Engineer, v. 31, no. 362, Feb., 1958.

Bangkok, capital of Thailand, is to have the largest mechanized composting plant ever built. Instead of dumping the garbage collected from the population of one million on the outskirts of the city, where land is urgently needed, the refuse will be processed and composted. A commercial company is to be established to sell to farmers and gardeners the clean granulated material, sterilized of germs and seeds, which is the product of the composting plant. This will help to improve the poor, dusty sand/clay soil which occurs in certain areas around Bangkok, reduce the need for imported fertilizers, and increase the rice crop, an important Thailand export.

The system to be used is a British method which has proved successful. The Department of Agriculture, Thailand, set up a pilot plant, which proved that the composting method produced compost of high value as a fertilizer. It is estimated that rice yields will be up 25 per cent and there are prospects that two rice crops a year will be possible; in this case the output will be up by 2½ times.

The Bangkok plant is designed to receive 1,100 cubic metres of refuse daily. Materials unsuitable for inclusion in compost will be removed from the refuse by magnetic and manual sorting, salvageable material being separated for sale. The remaining compostable garbage will be shredded mechanically and refined in ballistic separators, which will remove fragments of non-ferrous metal, ceramics, and so on, before sewage sludge is mixed with the garbage to form the raw compost. This will then be conveyed and distributed mechanically into special chambers in which the right conditions will be provided for the active development of aerobic fermentation in such a manner that temperature-duration conditions lethal to harmful organisms are created. The natural heat generated is also sufficient to sterilize weed seeds which would be a nuisance when the compost is applied to the land. The composting process can be operated with or without sewage sludge, the garbage being mixed with water if sewage sludge is not added. Present plans at Bangkok are that certain quantities of dried sludge will be brought to the site and added as required. With a suitable sewage system available, the conveying of sludge could be completely mechanized with both sewage wastes and refuse being disposed of in a combined disposal plant. The whole process is so hygienic that houses and schools can be built alongside. The plant is scheduled to come into operation in 1959. Some 80,000 tons of a safe and useful humus-forming compost will be produced annually.

Upon removal from the composting house, the compost is transported to maturing areas where it is formed into stockpiles. After six to eight weeks the matured compost will have a balanced nitrogen/carbon ratio. Most of the compost will be sold in bulk quantities. Power for the completely mechanized plant is provided by diesel-alternator sets situated in a separate power-house.

It is estimated that the sale of composted material will more than cover the costs of the plant and its operation so that profits can be set against the cost of refuse collection. The proportion of compostable material in the refuse at Bangkok is high, about 80 per cent, but even with a lower figure the system of salvage and composting is economic provided that there is a market for the composted material.

DEVELOPMENTS IN NEW ZEALAND

Civil Engineering (Britain), v. 53, no. 620, Feb., 1958.

Geothermal steam should be contributing to New Zealand's electricity generating capacity before the end of this year. This will make New Zealand the second country in the world to have harnessed steam from underground sources for the generation of power. The first country, Italy, now produces about 300,000 kw. from geothermal steam.

At the outset, a contribution of about 70,000 kw. will be fed into the North Island supply but plans are already in hand to increase the output beyond the 150,000 kw. originally envisaged.

About 50 bores have been drilled so far to an average depth of about 2,000 ft. and a maximum depth of 3,360 ft. and tests have shown that the amount of steam escaping is sufficient to produce 150,000 kw.

THE SAFE USE OF ISOTOPES IN INDUSTRY

W. A. Brobst, *Mechanical Engineering*, v. 80 no. 3, March, 1958.

The use of isotopes in industry, agriculture and medicine is already saving over $500 million annually in return for a direct outlay of about $3 million annually. By 1960 it is anticipated that these savings should increase to $5 billion.

Some examples of their use are as follows: tagging interfaces between different batches of oil flowing in a pipeline by introducing isotopes and measuring their penetrating radiation through the walls of the pipe; over 3,000 different types of isotopic thickness gauges have been licensed for use in the production of paper, rubber, plastics, glass, etc.; radiographic testing of welds and castings frequently at one-tenth the cost of X-ray radiography; radioactive tracing in studies of wear, corrosion, flow of lubricants, etc.; practical application of million-curie radiation sources about to be realized for food preservation, sterilization of drugs and medical supplies, and as catalysts for plastic reactions; cobalt-60 teletherapy sources; in agriculture the eradication of various pests, fertilization experiments and studies of soil-erosion.

Aside from possible toxic effects of the elements themselves, there are two primary hazards involved in the handling of radioisotopes. One is the external exposure a person can receive merely by being in the vicinity of a quantity of radioactive material, and the other is the intake of radioactive material into the body either by inhalation of the dusts or fumes, or by ingestion into the gastro-intestinal tract as a result of contamination of hands, food, beverages, cigarettes or other material which can carry contamination into the body. The seriousness and type of hazard for any facility using isotopes depend primarily upon the amount of the isotope present; whether it is solid, powdered, liquid or in some other form; and its biological effects. With very small tracer amounts for laboratory or field work, the external hazard is usually small, but the contamination problem might be significant. With sealed sources, as in radiographic or teletherapy units, the contamination is usually not a serious problem, and the external radiation levels are the governing factors. Each case will require special rules and regulations.

The most important practical duty of safety personnel, and of management, is to inform all individuals working in a restricted area of the presence of radioactive materials or radiation; to instruct them in the hazards of excessive exposure to such materials or radiation; and the precautions or procedures to minimize exposure and ensure that they are carried out. Instruction manuals and written procedures are necessary to make sure that all persons have the same information and handle the material in the same way.

The duties of the radiation-safety supervisor are to: (a) ensure that every worker selected to handle radioactive materials has suitable physical and mental requirements to qualify him for the work to be performed; (b) be responsible for the instruction of new personnel in safe working practices and in the nature of injuries resulting from overexposure to radiation; (c) establish and maintain operational procedures so that radiation exposure of each worker is kept as far below the maximum permissible as possible; (d) ensure that personnel-monitoring devices are properly used where indicated; (e) ensure that suitable warning signs and devices are in place and operating as required; (f) conduct radiation surveys, leakage tests, air and water sampling where required, and keep records on these surveys for future use by other groups; (g) ensure that shielding, storage containers, and handling equipment are maintained properly; and (h) maintain up-to-date operating instructions for the radiation equipment.

If the proper precautions are taken and the hazard is recognized for what it is, radioactivity can be utilized by industry with a maximum of efficiency and economy, and a minimum of danger. By the proper initial design of facilities and by the institution of safe, workable operating procedures the hazard from radioactivity should cause no more concern than other industrial hazards. The whole problem with radiation safety hinges upon education and understanding of the basic principles of safety.

CREVASSE DETECTOR BLAZES GLACIAL TRAILS

H. P. Van Eckhardt, *Electronics,* v. 31 n. 3, Jan. 17, 1958

Crevasses, hidden pitfalls often wide and deep enough to swallow men and equipment, have haunted Arctic explorers for many years. Bridged over slightly with snow, these chasms in the ice are particularly dangerous in summer Arctic white-outs and snow storms. Until recent years, the only methods used for detecting crevasses were aerial photography and hand-probing with long rods. Aerial observation proved effective only under highly favourable weather conditions and hand-probing was extremely tiring, tedious and slow.

A research program has resulted in the development of electronic techniques employing surface-electrodes for the effective detection of crevasses. The detector consists of a double system of electrodes. A wide system detects crevasses in a path around and in front of a vehicle. A long system detects crevasses with very thick snow roofs missed by the wide system, and distinguishes between large crevasses and narrow cracks.

Each system consists of four dishpan-shaped sled electrodes in contact with the ice or snow surface. The wide-system electrodes are pushed in front of the vehicle in a fanwise arrangement on wooden booms. Two pans act as current electrodes which set up an electrical field in the surrounding ice pack. The remaining two signal electrodes pick up readings from this electrical field. When the ice is solid and safe for travel, the signal is comparatively constant. As the vehicle approaches a crevasse, the flow of the electrical field is disrupted and an alarm signals danger. The long system operates simultaneously with the wide but on a separate frequency. One electrode is pushed ahead by the vehicle and the other two are towed behind at 20 ft. intervals.

As the vehicle travels over the glacial surfaces the detector reports its findings by a two-channel recorder, mounted in the vehicle. An alarm box containing a pair of special relay meters, a red light and a buzzer warns the driver of crevasses.

A source of alternating current is connected between two current electrodes, and a three-dimensional pattern of current flows through the ice. Since ice is a non-conductor, this is displacement current, like that flowing through the dielectric of a capacitor connected to an a.c. source. A potential-difference measuring device is connected between the signal electrodes. Any marked distortion of current pattern by an obstruction, such as a crevasse near the electrodes, will cause a change in the voltage reading.

PRE-CAST CONCRETE JETTY

Engineering, v. 185 n. 4792, Jan. 10, 1958.

A jetty of pre-cast prestressed concrete has recently been finished on the Thames to accommodate ocean-going colliers of 14,000 tons displacement. Three cranes each of 8 tons capacity have a maximum handling rate of 250 to 300 tons an hour. They are sufficient to ensure that a Liberty ship berthed on the flood tides can be sufficiently lightened to reduce its draught to less than 23 feet by first low-water tide. This means that some 4,000 tons of coal will have to be shifted within 8 hours. The cranes, which weigh 230 tons each, are able to lift their full load at 94 ft. radius and in the worst condition, each wheel of the three-wheel bogies could impose a 50 ton load on the jetty rails.

The jetty is L-shaped in plan. The straight approach arm consists of eight bays of 50 ft. span and the jetty head comprises 22 bays of 25 ft. span. At the connecting corner there are two lines of standard gauge railway track at radii of 150 and 160 ft. Deck slab widths are 34 ft. for the approach and 38 ft. 3 in. for the head, with an enlarged portion approximately 75 ft. by 70 ft. at one side of the junction.

The foundations for the jetty consist of 72 prestressed concrete cylinders varying in length between 35 and 65 ft. Each cylinder is built up of a number of hollow precast concrete units all of which have an outside diameter of 6 ft. and a length of approximately 5 ft. The concrete shell is 6½ in. thick and constitutes the main structural portion of the cylinder.

After vertical assembly of the cylinders in a special berth built against the wharf wall the units were post-tensioned together using the Lee-McCall system with 16 'Macalloy' bars of 1⅛ in. dia. spaced symmetrically around the shell. The bars were threaded through 2 in. dia. cored holes and, after stressing, grouted with colloidal grout.

To facilitate sinking, each cylinder was fitted with a cast-steel shoe which was filled with mortar prior to launching. The weight of the 65 ft. hollow cylinders was about 40 tons each. They were open-ended and were sunk by grabbing and loading with kentledge blocks. After each cylinder had been placed, silt and mud were removed by a diver and a concrete plug made in the bottom, then the hollow columns were pumped dry and filled with low-grade concrete.

In the approach arm the foundation cylinders, 25 ft. apart and at 50 ft. longitudinal centres, are connected by *in situ* concrete main cross beams which have a precast prestressed soffit. Stringer beams, also a pre-cast and prestressed span between the main beams and the whole structure, are integrated by a 7 in. reinforced deck slab cast *in situ.* Nearly all stringer beams are seated on pre-cast concrete plinths. They are of a modified I-section with solid end blocks and are 48 ft. 0½ in. long with a tolerance of plus zero, minus ½ in. To transmit the horizontal shear forces the top surfaces of the beams have shear connectors of ½ in. dia. bar hoops at 8 in. centres.

Few of the pre-cast units exceeded 7 tons in weight. A screed of mass concrete has been placed over the length of the jetty to produce a finished deck. Electrical services, aircraft runway lighting, and water supplies for the vessels are contained within the deck screed.

INTERNATIONAL NEWS

The Technion and the State of Israel

TEN YEARS AGO, in 1948, the Technion (the Israel Institute of Technology) had a scholastic tradition already more than two decades old, but the enrollment was still not high. There were 669 students, and a teaching staff of 48. During its entire lifetime, the Technion had created less than one thousand engineers, architects, and technologists, but these had played prime roles in the development of the young country.

At the head of the Technion was Dr. Shlomo Kaplansky, distinguished Zionist leader and economist who, until his death in 1950, guided the Institute through eighteen years of development.

The War of Independence forced the Technion to suspend its studies for a period of one and a half years and, during this crucial period, the Technion laboratories and workshops were kept working to full capacity to supply the army with essential equipment. Fifty-four students of the Technion fell during the war.

With the birth of the State of Israel, a tremendous responsibility fell to the share of the Technion. As the only institute of university rank offering undergraduate courses in engineering, architecture and technology, it had to answer the urgent needs of the young State for skilled manpower in every branch of industrial activity. The vital task of absorbing new streams of immigrants and promoting Jewish settlement in the country was one in which the Technion played a leading role. Research, pure and applied, was urgently called for, and the testing and consulting services of Technion laboratories and experts were constantly in demand by Government and industry.

In 1952, the Technion Research and Development Foundation Ltd. was founded, in order to co-ordinate and centralize research projects carried on by the Technion or sponsored by agencies in Israel and abroad. More than 120 research projects have been pursued through these channels.

In the ten years since 1948, the number of faculties and departments has grown to include practically every branch of modern engineering and technological science. In chronological order of their establishment, they are the Faculties of Civil Engineering, Architecture, Mechanical Engineering, Electrical Engineering, Chemical Technology, Science, and the Departments of Agricultural Engineering, Aeronautical Engineering, Metallurgy and Mineral Engineering.

Now known as the Technion, Israel Institute of Technology, the school has a student enrollment of over 2,000, and an academic staff of more than 500 full and part-time teachers. The number of its graduates has risen to 2,500. President of the Technion is General Yaacov Dori, himself an engineer by training.

In recent years, and particularly

At right is a group of students in front of the new Harry F. Fischbach Electrical Engineering Building at the Technion, Israel Institute of Technology. Below is the Aeronautical Engineering Building.

since the establishment of the Faculty of Science, the Technion's scientific standard have been brought into line with those of leading universities, all over the world. A wide range of higher studies are being pursued through the Graduate School, where over 200 young men and women are working for Master's and Doctor's degrees. Many of these will rise through ranks of the academic staff to become the senior teachers of later generations of students.

Built in 1912 to accommodate some 600 students, the main Technion building on Hadar Hacarmel was supplemented by 28 other structures on the eight-acre campus. However, the rapid expansion which has taken place in the ten years since the founding of the State caused serious overcrowding at the Technion, and the lack of sufficient space forced the authorities to turn away large numbers of candidates for admission each year. To enable the Technion to expand and build new laboratories, install much-needed new equipment, and accommodate larger numbers of students, the Government of Israel placed at its disposal a 300-acre tract of land on the northern slopes of the Carmel, and in 1953 the cornerstone of the first building on the new Technion City was laid.

Since then, with the active cooperation of friends in the United States, Great Britain, South Africa, Latin America, and Israel, ten new buildings have been completed on the new campus and others are under construction. More than 200 students live in the well-planned and comfortable dormitories, and over half the student body are now devoting themselves to their studies in the beautiful surroundings which have already earned Technion City fame as one of the most beautiful campuses in the world.

SWEDEN

KEEPING SHIPPING LANES OPEN WITH COMPRESSED AIR

Successful Swedish experiments have been carried out in recent years to keep shipping lanes free from ice by bubbling air up from submerged plastic pipes. During the past winter a 4-mile test installation has operated in Lake Mälar. The picture shows the ice-breaker *Thule* entering the test channel when opening Mälar port traffic on 27 March. The surrounding ice was up to three feet thick. White edges along the channel are frozen snowdrifts. The compressor for the test route is driven by a 100 h.p. electric motor, which is more than adequate for the 4-mile stretch.

BELGIUM

INTERNATIONAL FAIR

The universal and International Exhibition was opened at Brussels, Belgium, on 17 April and will continue until 19 October. It is the first exhibition of this scope to be held for twenty years.

A town of 490 acres has been built on the outskirts of Brussels, and will be the meeting place of forty-six countries and eight international organizations.

The Belgian section covers 110 acres and includes a group of 'Grand Halls' and other buildings in which are displayed the industrial activity, scientific achievements, and cultural life of the country. Another large group is devoted to the development of the Belgian Congo and Ruanda Urundi.

The dominating feature of the Exhibition is the Atomium, a 350-ft. high structure of nine spheres arranged as a body-centred cubic lattice standing on one corner. The spheres are some 59 feet in diameter and are connected by 10-ft. diameter tubes which contain elevators and escalators. The metallic structure weighs some 2300 tons and rests on a 500-ton concrete foundation.

Four lower spheres house an exhibition of the peaceful uses of nuclear energy. Two spheres, including the upper one, contain restaurants and lookout galleries. The whole interior is air-conditioned.

The foreign section, linked to the Belgian section by a bridge, 81 ft. wide, 51 ft. high, and 430 yards long, is a park of 550,000 sq. yd. in extent and contains the Halls of the participating countries.

The Canadian Hall covers some 10,000 square yards and is designed to give an impression of space. It is a steel framework, partly open and partly encased in blue glass panels. A 125-ft. long, 10-ft. tall mural depicts Canadian enterprise and industry, and there are 23 further exhibits of Canadian resources.

There are international sections for science, art, and organizations such as the United Nations, Red Cross, and so on; gardens of all ages; a Belgian town of 1900; and many facilities for conferences.

It is hoped to give further details of the many interesting structures and other features in future issues of the *Journal*.

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

St. Lawrence Seaway and Power Project

Progress by Ontario Hydro

Weather conditions during all of February and in the early part of March were unfavourable but the latter part of the month improved greatly. The total work force at the end of March was 2,550 persons. In February it had averaged 2,775.

With four turbine runner assemblies in place, headgates in place for seven units, and all steel stoplogs installed during February, installation of the rotor for the second of the sixteen generating units in the Ontario half of the international power-house was completed during March, in unit No. 1. Earlier in March, the 225-ton rotor had been installed in unit No. 3. Work had commenced on the lower brackets for generating units two and four. Assembly of the rotors for these units also was progressing favourably.

Three transformers were installed on the downstream side of the power-house main deck. These transformers will receive power from the first four units when operations commence this summer. Construction of the switch gear and bus work was proceeding for the first unit. Station service transformer was installed and control was proceeding for the first four units. Installation of control equipment had commenced for units five and eight.

Meanwhile, concrete placing was proceeding around units ten to thirteen. All the headworks concrete was completed earlier in the month. Total concrete placed to end of March in the power-house was 935,000 cubic yards. As major placing operations neared the end, the downstream construction gantry and the gantry on the upstream side of the power-house were removed.

All preparations were completed for the breaching of C-1 cofferdam scheduled to start at month end. This work began at cell 28 at the international boundary where the cell is being unloaded and removed to flood the tailrace. The cofferdam is being removed cell by cell working backwards from both sides of the international border.

At the St. Lawrence transformer station, the control building was 90 per cent completed. Installation of the breakers was proceeding, as well as the extension of the 230 kv. area to receive power from the generating station.

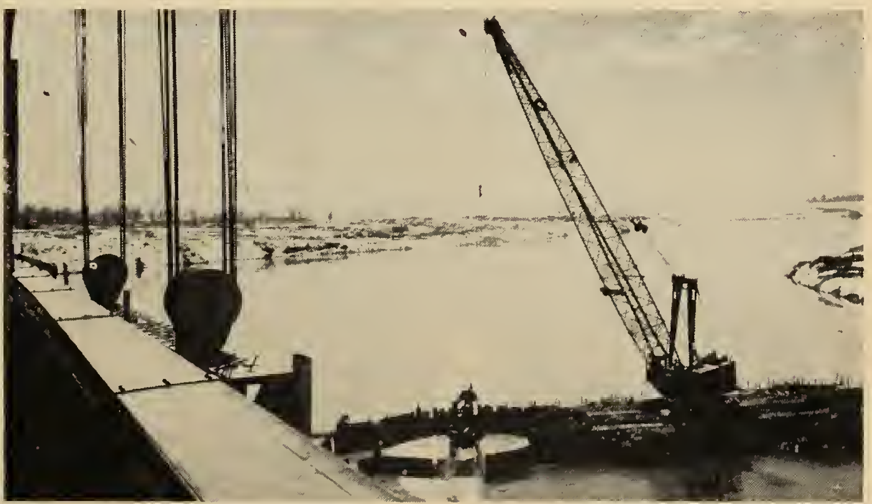
Final clean-up of the area to be flooded was being held up for improved weather conditions, but it got underway in April. Meanwhile in Morrisburg, the demolition of the former main business area was 95 per cent completed, and work now had started on shoreline improvements. The Morrisburg pumping station was completed in February.

Construction continued on the United and Anglican churches in Iroquois. The Anglican manse was ready during April. At Ingleside, construction had resumed on the Anglican Church and manse as weather moderated. All interior work was completed in the United Church ready for handing over to church authorities. All hydro and telephone lines in Osnabruck Township to be flooded, had been removed.

Progress by NYSPA

March was highlighted by transfer of the operation of the Massena intake pumping plant to Alcoa. Concrete in place at end of March for all structures totalled 1,933,000 cubic yards or 94 per cent of the estimated total. Excavation quantities had reached 49,900,000 cubic yards or 94 per cent. Employment averaged 2,260 for the month, compared with 1,830 for February.

On the American half of the power plant approximately 3,700 yards of concrete were placed during the month. The quantity placed to end



Long Sault dam. Removal of cofferdam DU was in progress in March and fill material was being excavated from cofferdam cells.

of March was 96 per cent of the total. Four generator stators and three rotors were in place and two more rotors were being assembled in the erection bay. Five runner assemblies were in position in the units. The installation of drum gates in ice sluices 5 and 6 was completed. Excavation in the unwatered tailrace area was completed.

At Long Sault dam, removal of the earth and rockfill portion of cofferdam DU was completed and the removal of cells was continuing. Cofferdam DU was breached on March 15 and removal of cells was in progress. The three caissons to be used for placing stage III concrete in the spillway diversion openings were lowered into position on the downstream side, and placement of concrete started on March 19. The river had been partially diverted through tunnels in the stage II portion of the structure.

Removal of cofferdams at Iroquois dam was completed early in February and remaining contract work was postponed until spring. Channel improvement work continued during March with two dredges completing work at Sparrowhawk Point and resuming removal of the rim dike at Toussaints Island. Removal of the causeway between Toussaints Island and Presque Isle was completed early in March. Channel work on the entire project was 94 per cent completed at month end.

Power facilities to provide the permanent power supply for the Grass River lock were completed and cutover from the temporary facilities was accomplished ahead of schedule on March 9. Construction was started on dike relief wells, dike observation wells and groundwater investigation wells within the project areas.

Some 80 per cent of the poles had been set and 8 miles of the Barnhart-Plattsburg transmission line were completed. Concrete was being placed in tower footings and erection of tower steel was started for the Plattsburg substation.

Tower steel continued to be moved to tower sites as tower erection was started for the north extension of the Barnhart-Adirondack 230-kv transmission line.

Progress by SLSA

Following severe blizzards and extremely cold weather throughout February and the first half of March, mild and clear weather obtained over the second half of the month. Employment, which averaged 3,500 persons in February, increased to some 4,000 during second half of the month as work on steel erection was speeded up.

At the St. Lambert lock, with all concrete placed and stoplogs and one spare downstream gate installed, erection was being commenced on the lower mitre gates. At the Cote St. Catherine lock preparations were underway for resumption of concrete placing and dikes were being trimmed up. Installation of gates and gate machinery started during April.

On the Upper Beauharnois lock rock excavation was continued during the winter months. Placing of concrete; discontinued during the cold weather, had been completed for the upstream gate section and on both walls of the chamber for about half its length. On the lower lock, both walls of the chamber had been poured to full height for some 80 per cent of their length as well as the lower gate section and upper entrance wall one side. Placing of concrete at both Beauharnois locks was scheduled to be resumed early in April. Piers had been poured for the Valleyfield and St. Louis bridges over the Beauharnois canal, and preparations were underway for an early start on steel erection.

At the Iroquois lock, dredging of the rock in the approach channel to a depth of 14 feet had been carried on during the winter months, but was discontinued at mid-March to permit overhaul of equipment. The lock and channel were ready for service at the opening of lake navigation on April 15.

Channel excavation had been completed at month's end for the stretch of some seven miles between the lower end at Montreal harbour and a point three miles above Victoria bridge. Channel excavation had been resumed on the Northern Construction Co. contract along the Laprairie Basin. The channel was completed for some 2 miles upstream from the C.P.R. Caughnawaga rail bridge. On the Welland Canal, winter work on the channel at Port Colborne had been completed and rock dredging and clean-up was continuing at Thorold. Dredging at Port Weller was completed.

The Canadian National Railways are engaged in constructing an alternative line for diversion of rail traffic over the upstream end of the St. Lambert lock at times when the new lift spans on Victoria bridge are raised to accommodate shipping.

Bridge Construction

Progress has continued steadily on bridge construction during February and March in spite of cold weather and heavy snowfalls. On the Jacques Cartier bridge, numbering from the south shore, piers 1 to 5 are raised to final height. Jacking at piers 6 to 13, including the new through span between piers 9 and 10 placed last October will continue throughout the summer, with completion expected in September. The new span still required to be raised a further 40 feet at end of March.

At the Victoria rail-highway bridge with road traffic diverted to a partially completed alternative crossing upstream, structural steel was in place for upstream roadway over the seaway channel and being erected for the downstream roadway. One of the towers for the double-track lift span was erected and erection of the other was proceeding at end of March, with target date for completion at end of July.

At the Honoré Mercier highway bridge, the first 11 steel girder spans were in place on the new piers at the south end and forms were being placed at end of April for the concrete bridge deck. With temporary timber falsework in place across the seaway channel, erection of the channel span was under way. Further south, steel girders were in place for the last nine spans to connect with the new rock fill which will join highway 3 leading to Laprairie, and forms for the bridge deck were being set.

On the C.P.R.-N.Y.C. rail bridge at Caughnawaga both lift spans for the double track on the new location across the seaway channel were in place and all four lift towers erected, as well as one counterweight.

Roosevelt Bridge Closed

After April 1 the south channel section of the Roosevelt international bridge ceased to be available for traffic. This section crosses the south channel of the St. Lawrence river between Cornwall Island (in Canada) and the mainland of the United States, near Rooseveltown, N.Y. Highway and pedestrian traffic between these points is now being carried by the ferry, *John J. Walsh.*

The north channel part of the Roosevelt international bridge, provides crossing between Cornwall and Cornwall Island. A new south channel bridge which will provide the requisite 120 foot overhead clearance for ships is being constructed jointly by SLSA and SLSDC.

Seaway News

First step in the development of Nun's Island and the construction of the $26 million bridge linking Verdun with the south shore of the St. Lawrence opposite Montreal was taken on March 11, when work commenced on a causeway linking the island with the Verdun shoreline. It will be used by the contractor to sink cofferdams for the piers, and by crews of the Quebec Homes and Mortgage Corporation which is developing the island. Work on the apartment buildings will begin in the spring.

Ottawa Studies Aids for Winter Shipping

Winter navigation in the lower St. Lawrence is now assumed to be only a few years away, according to Department of Transport officials. A three-man team of economists and engineers is studying existing facilities and suitability of Department of Transport harbours such as Rimouski, Riviere du Loup, Pointe au Pere and others, as winter ports.

Vital for general development of winter shipping are the services to be provided, such as icebreakers and aids to navigation. By 1961/62 at latest, the government expects to have a fleet of heavy icebreakers available for St. Lawrence service. The main navigational aid requirements are buoys and lights. Installation of automatic lights may solve the problem of keeping light keepers on duty through the winter. Marker buoys would have to be of a special type, heavier than summer buoys and requiring regular inspection service.

The Meteorological Service Division has been training men for expert work as ice observers for aerial inspection and for making ice-maps and forecasts of ice movements. Chartered aircraft are being engaged earlier than usual this year for regular observation trips. Next year it is intended to maintain regular inspection surveys throughout the winter.

Captain R. G. Edwards, port captain for Canadian International Paper Co., who completed a 2,000 mile air survey from Montreal to Newfoundland early in March, stated there was little to hamper winter shipping at that time. "Ships could easily reach the eastern docks of Montreal harbour right now", he said.

Canadian Pipeline Projects

British Columbia Electric

At the end of 1957, B.C. Electric was serving 24,000 residential heating accounts, compared with only 3,000 at the beginning of 1956 when it was serving customers with manufactured gas. The company received gas distribution franchises from 14 Fraser Valley communities during 1957. Capacity of its system is now 130 million c.f.d. At year-end the company had installed 1,400 miles of mains on the B.C. mainland and 150 miles on Vancouver Island. Its peak-day sales during the winter 1957-58 reached 36 million cubic feet. The company's gas division estimates peak-day sales will increase 300 per cent by 1962.

Alberta Gas Trunk Line

Trunk Line's construction program for 1958 includes a 55-mile westerly extension of the 34-inch mainline; a 24-inch-diameter lateral from the Pincher Creek field, 145 miles in length, to the Princess main line junction; a 26-inch lateral 24 miles long to the Cessford field; an 11-mile lateral of 6½ inch diameter from the Bindloss-Provost line to the Sibbald field; and small laterals to tie in the Atlee-Buffalo, Princess and Steveville fields. A contract has been awarded to Pigott Construction Co. for construction of the 145-mile line from Pincher field at a cost of $1.5 million. Welland Tubes Ltd. is supplying the pipe. Total cost of the line will be approximately $11 million.

The company expects to operate at a loss during the first four years of operation from September 1957. Agreement with Trans Canada calls for Trans Canada to pay four cents per M.c.f. during the first four years, effective as long as it provides the following minimum payments in 12 monthly installments: $210,480 the first year; $2,312,640 the second year; $3,326,400 the third year and $3,621,760 the fourth year.

Alberta Trunk had awarded two large contracts early in March for stringing. Campbell McLeod and Campbell was awarded the stringing for the 24 miles of 24-inch pipe to Cessford, while the 144 miles of 24-inch pipeline out of Pincher Creek will be strung by Hutchison Construction, Ltd., of Leduc. Contracts for three major river crossings over the Bow, Old Man, and Red Deer rivers have been awarded to Fulton-Bannister Ltd.

Two river-crossing jobs on the Goliad gathering system for natural gas in the Pembina Oil field were awarded to Marine Pipeline and Dredging, Ltd., of Vancouver, and both were completed in March. One involves a crossing of the Saskatchewan river 2,500 ft. long, while the other is a 4-inch crossing of the Pembina river 650 ft. long.

Trans Canada Pipelines

Winter work was in progress during March in southern and central Ontario. Pipe was being strung along most of the right-of-way for both the Trans Canada line and the 1958 section of the Crown Corporation line where weather and ground conditions permitted. Canadian Willett-Gaby, Ltd., was stringing on spreads *Y* and *Z*, Mannix Ltd. was stringing on spread *Y*; Canadian Construction Ltd. on spread *Z*. Spread *V* had been awarded to Dunn Bros. (Canada) Ltd. Canadian Parkhill Stringing Ltd. was stringing on Spread *X*.

On the Trans Canada line, spreads 8, 9, 11, 12 and 13 will be strung by Parkhill. On spread 10 Dutton-Williams Ltd. will do its own stringing and on spread 14 Oklahoma Constructors will string its own pipe. Price-Poole will double-joint most of its spread 13 as most of it can be handled off the highway. Majestic has its entire spread organization set up for spread 9 between Potter and Kirkland Lake, and pipelaying is scheduled to start early in June. Grayco Constructors will be on spread 8 from Kapuskasing to Potter. Marine Pipeline and Dredging Co. has a contract from Trans Canada for a buried crossing under the Welland Canal in south eastern Ontario.

Presently authorized gas supplies to Trans Canada will not meet demands in 1960. Contracts now add up to 520 million c.f.d., while nearly 21 trillion feet will be needed over the next 20 years.

Trans Canada's 1958 compressor station program calls for installation of 48,500 hp., or 20,800 over what was originally planned for 1958. This will enable the system to serve the midwestern United States if permits are obtained, or alternatively will provide facilities to serve expanded Canadian markets as they build up.

Canadian Western Program

The 1958 construction program of Canadian Western Natural Gas Co., Ltd. contains five items valued at a total of $1,726,000 in addition to the 55-mile 16-inch main pipeline from the Carbon gas field to Calgary. Additions and improvements to the Bow Island field will cost $298,000; transmission line replacements and improvements will cost $137,000. Largest single item is $640,000 for extensions to local distribution systems. New services and regulators are valued at $403,000. Only major extension planned for 1958 is a line from the Alberta Trunk System to serve Vauxhall. All these items will be handled by the company's own crews.

Northwestern Utilities

A record expansion program, costing an estimated $6.5 million to improve and extend its pipeline system and to service new areas, is planned for 1958. Major item is construction of a 70-mile, 16-inch line from the Pembina field to Edmonton, costing $3.8 million, on which work had already begun in March. Northwestern will buy residue gas produced with crude oil at the Pembina field. Quantities to be purchased are estimated at 65 million cubic feet per day.

The company plans to provide natural gas service to Provost and Cadogan, supplying these communities 160 miles southeast of Edmonton from the Provost gas field. There are about 365 customers who can be served in this area. Cost of this new installation is estimated at $310,000. Some 445 customers in Oyen, Consort and Monitor also will be served by connection to the Trunk Line system, at a cost of about $210,000.

Extensions to the present distribution systems will cost more than $400,000 this year. More than $700,000 is provided for installations for new customers, and for measuring and pressure-control equipment. Improvements to transmission and distribution systems will total $320,000. More than $300,000 is provided for expansion of production facilities, including the acquisition of natural gas rights.

Canadian Western Natural Gas and Northwestern Utilities Ltd. which together serve 145,000 Alberta consumers, will together require more than 260 billion cubic feet yearly within the next 30 years, or triple present needs, according to President D. K. Yorath. Peak demand by that time will rise to 1,650 million c.f.d., or three times presently authorized average daily demand of Trans Canada Pipelines.

(Continued on page 97)

The *Journal* Reports Growth in Engineering Faculties in Canada

Fifth article of a series.

The Department of Engineering Dalhousie University

Dr. H. R. Theakston, Head of the Department of Engineering, Dalhousie University, Halifax, reporting on the *Journal* for this series, gave a review of the structure of engineering education in the Atlantic Provinces. The scheme is different from that in the remainder of Canada.

Prior to 1909, Dalhousie University had, for some years, been giving bachelor of engineering degrees in civil and mining engineering. That year the Nova Scotia Technical College was opened by the Province of Nova Scotia to give the final two years of the degree course. The other Maritime universities, with one exception, were to give a three-year (from junior matriculation) general course in engineering common to all branches. Students, on successful completion of this course, would proceed to their final two years of specialization at the Nova Scotia Technical College. Most students have done so, although each year some few proceed to Queen's, McGill, M.I.T., etc.

The exception to this scheme was the University of New Brunswick, which for many years had given bachelor degrees in engineering. Latterly, however, U.N.B. has been associated with the Nova Scotia Technical College in chemical and mining engineering.

Colleges Associated with N.S.T.C.

Those colleges now associated with the Nova Scotia Technical College are Acadia, Dalhousie, Memorial of Newfoundland, Mount Allison, St. Francis Xavier, and Saint Mary's Universities.

The Department of Engineering at Dalhousie gives the courses in drawing, surveying, mechanics (including kinematics and graphical statics), strength of materials, and materials of construction. The other courses are given by other departments in the faculties of arts and science.

No great changes in courses or content are anticipated in the near future at Dalhousie, Prof. Theakston reports. The course is kept quite fluid, and the Associated Universities are in constant contact with the Nova Scotia Technical College, and minor or major changes are made frequently. Incidentally the deans or heads of Engineering Departments at the Associated Colleges are members of the Senate of the Nova Scotia Technical College.

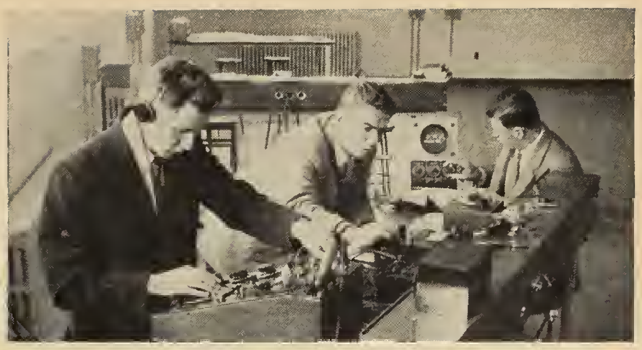
Dalhousie University has four full-time staff members in the Engineering Department, two of them also being responsible for the maintenance of the physical plant of the university.

New Science Building

There is a new building now under construction at Dalhousie, the Sir James Dunn Science Building, made possible through a gift by Lady Dunn of nearly $2 million. This building will house the Departments of Physics, Engineering and Geology, construction having been started about the middle of April, 1958. The move of the departments into the new building will be made in 1960.

The space to be vacated by Physics in the present science building will be taken over by the Chemistry Department which is now using about half of the building. The building presently occupied by Engineering and Geology will be made available to other university activities.

Electrical Engineering Building, University of Ottawa.



Students in the electronics (top) and power laboratories.

Electrical Engineering Building
University of Ottawa

The University of Ottawa has recently completed a new Electrical Engineering Building consisting of two stories and basement, the plan size being approximately 140 feet by 50 feet. The basement houses a small workshop, standards room, storage for heavy equipment not in use, and similar facilities as well as the d-c power supply and a small storage battery. The two "teaching" floors house two classrooms, a seminar room, power and electronics laboratories with their instrument rooms, research laboratories and offices. The flat roof is planned for antenna experiments.

This building was originally planned for classes of 15-20 students in the graduating year in electrical engineering and "EE service courses" of about the same size for students in chemical, civil, and mechanical engineering. The facilities are, of course, supplemented by the other buildings of the university, in which students spend the first two years of the five-year engineering courses. They will also be supplemented, in due time, by other engineering buildings where third, fourth and fifth-year electrical engineering students will receive "service courses" in mechanical engineering subjects and the like.

Modern equipment is being purchased for instruction in electrical engineering, and a number of donations have been received from manufacturing firms. Power equipment is of ratings which are sufficient to present true pictures of commercial practice and yet of economical size. Only a limited amount of such equipment is being permanently installed, the remainder being removable (by portable crane and freight elevator) to basement storage. The objects of these provisions are maximum emphasis on basic principles with minimum emphasis on trades training, and economy of teaching floor-space. The flexibility of the laboratory arrangement of both the power and electronics laboratories is intended to allow of the most modern innovations in equipment and in teaching methods being introduced whenever changes appear desirable.

Increased Enrolment in September
Sir George Williams College

Sir George Williams College, Montreal, has for many years been teaching a pre-engineering (senior matriculation) year as part of its science degree program.

In 1956 the College moved into modern quarters making it possible to add two years of engineering to its curriculum.

By September 1958 the College will be offering the first three years of a five-year course to a limited number of students in civil, mechanical, electrical, and chemical engineering.

The program is being offered in both day and evening divisions of the College making it possible for an evening student to complete the three academic years in six calendar years.

It is planned to admit forty new students into the second year in each division in September 1958.

Jack Bordon, M.E.I.C., Associate Professor of Engineering, is head of the Engineering Department.

Diamond drill exploration showed the possibility of the mining operation. In November, 1955, the contract was awarded to Northern Construction Company, J. W. Stewart Ltd., and Boyles Bros. Drilling Co. Ltd.

The shaft at Maud Island went down 570 feet. The 2,000-ft. tunnel, 6 ft. by 7 ft. high, mined out to Ripple Rock base, was a minimum of 100 feet below the channel floor. From the base, two main shafts, 15 ft. by 7 ft. were driven upward about 300 feet. Radiating from these there were sub-levels, and "coyote" tunnels into which the explosive was packed. The rock was honeycombed with Nitramex 2H, an imported explosive the use of which was technically directed by Du Pont of Canada.

Safety in the mining operation was ensured by emergency pumping equipment, and steel emergency doors designed by Vivian Diesels and Munitions Ltd. to close automatically on any abnormal flow of water.

Public safety was provided by designating as an evacuation zone an area within 3 miles radius of the centre of the blast, as determined in recent tests by the firm Racey, MacCallum and Associates.

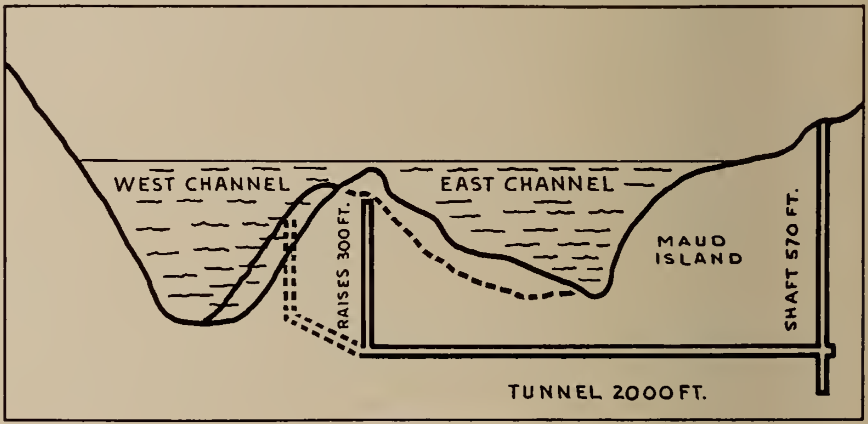
Seismographic stations in Western Canada measured the effect of the blast and their records will form part of Canada's contribution to the International Geophysical Year. Hydrographic and geophysical information about the calculated blast will be available only later, and the editors hope to be able to publish more on this aspect. The explosion was as spectacular as expected, as the climax of the $3 million project was witnessed with attention by a nationwide television audience.

End of Ripple Rock

It took two and a half million pounds of explosives to de-cap Ripple Rock, but the task was completed successfully on April 5. So the Strait of Georgia in British Columbia is rid of a navigation menace at Seymour Narrows that has withstood all earlier attempts at demolition. First surveys showed the channel to have a minimum depth of 47 feet at low tide.

The drawing shows the tunnel plan adopted by the Department of Public Works as the best method of attack on the two underwater peaks. The National Research Council was requested in 1953 to undertake research. The underground approach which they favoured was accepted by the Department. Dr. Victor Dolmage, consulting geologist and E. E. Mason, consulting mining engineer, both of Vancouver, were employed to work under the direction of the chief engineer, Harbours and Rivers Engineering Branch.

Ripple Rock stood in the Seymour Narrows, an obstacle in the shipping lane between Vancouver and Alaska via the Strait of Georgia. This is the inner passage between Vancouver Island and the B.C. mainland, and at this point it is only 2,500 feet wide. The tides became turbulent over the two peaks, 450 ft. apart, reaching to within 9 and 20 feet of low water, while the channel at either side of the rock is 325 and 400 feet deep. The cross currents have caused the loss of some 100 small vessels and the loss of or severe damage to 14 large ships. A toll of 114 lives is attributed to this hazard. Ships waited hours to navigate the passage during the 20 to 40 minutes of slack tide twice a day.



Tunnel to Ripple Rock

Canadian Pipline Projects

(Continued from page 94)

Saskatchewan Power Corporation

One of the largest programs in its history at a total cost of some $16 million, has been announced for 1958 by the S.P.C. Confirmed are major additions to the main pipeline system and a large gathering system in the Hatton field. More than 300 miles will be built as well as an undetermined amount of footage for local distribution systems. Largest job is the 90 mile 14 inch line from Hatton to join up with the line from the Success field to Moosejaw. Some 75 miles of gathering lines will be laid in the Hatton field. The Extension from Moosejaw to Regina will take 40 miles of 21-inch pipe. From Regina to Weyburn and Estevan there will be 125 miles of 10 inch line.

It is not yet announced how the work will be distributed for the purpose of awarding contracts. Pipe will be supplied by Prairie Pipe Manufacturing Co. Ltd., from its Regina mill, under a long term existing contract with S.P.C. Ultimate objective is to provide gas service for every community within economic range, regardless of size and to every community of 1,000 population or more.

Northern Ontario Natural Gas

Detailed surveying for the 88 mile Sudbury lateral was completed in February. Actual construction is scheduled to start May 1. Cost exclusive of distribution systems will be $4.7 million. Fish Service, an engineering consultants firm, is retained by Northern Ontario Natural Gas to supervise the latter's initial construction activities. This year 'Northern' will spend $15 million building distribution systems and laterals to supply communities throughout northern and northwestern Ontario.

Signing of a third large industrial gas sales contract was announced late in February. This contract provides for delivery of some 18 billion cubic ft. of gas over a 10 year period to the Spruce Falls sulphite pulp and newsprint mill at Kapuskasing at a cost of $7,750,000. Gas will fire the steam boilers. Delivery will start later this year when gas becomes available from Trans Canada and when conversion on the boilers is completed.

Twin City Gas

Twin City Gas Co., affiliated with Northern Natural Gas Co., and Dryden Paper Co. Ltd., report that the latter will convert to natural gas this year. A sales contract provides for delivery over a 10 year period of some 10 billion cubic feet to the Dryden mill. This will average 2.7 million c.f.d. over the whole contract term. The new fuel will fire the two main mill boilers, producing steam for drying paper and pulp and for other purposes. Delivery will commence in October, 1958.

Consumers Gas Co. of Toronto

Natural gas service will be extended to some 20 additional communities in Georgian Bay and Ottawa Valley areas during 1958. Construction of pipelines and distribution systems will commence early in the summer. Georgian Bay communities will receive the gas by September, while completion date for the Ottawa valley communities is set for about November 1. The construction program will employ more than 500 workers, the Company reports.

Quebec Natural Gas

The Company's proposed new rate structure was expected to be submitted to the Quebec Electricity Board during the latter part of April or early May. Preliminary findings indicate the Montreal price for the first 1,000 cubic feet per month will be 44 per cent lower than the Toronto price for the same service when natural gas was first introduced there three years ago. The Toronto price was then $4.12 per M, since reduced to $3.94. Quebec Natural estimates $30 million or more will have to be raised to implement the long-term program of building lines into communities not presently served.

Midwestern Case

The bitterly contested Midwestern Gas Transmission project took a dramatic turn early in March with withdrawal of opposition by a Chicago utility, People's Gas and Coke Co., Ltd. To get the project going, however, Midwestern must not only overcome continuing strong opposition from Northern Natural Gas and American Natural Gas, but must cope with uncertainty as to decisions of the Borden Commission. But Midwestern gets a break when opposition to the southern section of the pipeline disappears.

What Goes On

Stelco Expansion

The new blooming mill of the Steel Company of Canada at the Hamilton Works was opened in February.

The mill, representing an investment of $25 million, will allow Stelco to handle the increase in steel production expected between now and 1980. It is only part of a $70 million expansion program nearing completion.

The mill is a 3-acre building, capable of handling 2.8 million ingot tons annually. The rolling operation is adaptable to 30-ton ingots.

Production begins in Stelco's new mill at the 12 soaking pits which are 18 feet square and 11 feet 6 inches deep. In these pits, which will use a fuel mixture of blast furnace and coke oven gas, ingots will be heated to proper rolling temperatures, about 2350 degrees F.

Once an ingot has been selected, it will be placed on a cable-driven roller top ingot buggy which can operate at 1000 feet per minute.

After the ingot reaches the mill table which stretches 425 feet in length, it proceeds to the nerve centre of the operation which is the 46-in. x 100-in. mill proper with a 78-in. lift. The first dimension is the nominal diameter of the rolls, the second corresponds to the width of the mill, and the latter is the maximum opening between rolls.

This huge mill is powered by two, 5000 horsepower motors and is operated from the entry side by two men in a pulpit located above the mill table.

The steel, after being reduced to slabs, proceeds downstream to an electric shear which crops the slabs to required length. They are subsequently stamped automatically with the ingot number, heat number and whether top cut from the ingot. The slabs move along to either of two piling tables where they are stacked on a transfer car. From here the slabs are taken on railway flat cars to subsequent rolling operations.

Also slated for completion early in 1958 are the reversing cold mill, additional batch annealing furnaces, the No. 2 temper mill, and the new metallurgical and chemical laboratory.

Place Ville Marie, Montreal

Huge Urban Development

The general contract for the construction of the Place Ville-Marie project in Montreal was awarded to the Foundation Company of Canada Limited, in March by Webb & Knapp (Canada) Limited.

Place Ville-Marie Corporation, a recently formed subsidiary operating firm is entrusted with the construction and management of the development, located on property leased for 99 years from the Canadian National Railways.

Plans call for completion of the entire Place Ville-Marie development within four years at an estimated cost of $60 million. It will contain a 40-storey aluminum and glass cruciform office building, another major 15-storey office building, a wide pedestrian plaza with shopping concourse and a three-level 900-car underground parking garage.

Foundation explorations started in April. Canadian National Railways have also announced their plans to build immediately a $15 million railway administrative building south of the Queen Elizabeth Hotel in accordance with Webb and Knapp's master plan.

Toronto Harbour Improvement

Two projects currently under way in Toronto harbour are the dredging of the harbour and the building of Terminal No. 15, now nearing completion. On this page is an early progress picture of the Terminal, a steel frame and masonry building, 475 ft. by 200 ft., providing total floor area of 100,000 sq. ft. It has a monitor type roof, with 100-ft. clear span in the centre portion and 50-ft. spans on either side.

Ice-Free Construction

Dravo of Canada Limited, Toronto, used an underwater aeration process in constructing the substructure for a highway bridge in sub-zero temperatures at Vernon Lake Narrows at Huntsville, Ont.

In the aeration process, compressed air is passed through holes in a plastic pipe laid across the channel floor. Despite temperatures as low as 30 deg. below zero, floating construction equipment was able to operate in a 200-ft. wide strip of open water across the channel.

Dravo was building eight concrete piers and two abutments for the 810-ft. span, and expected to complete its phase of the work this spring.

A terrace of factories for light industry on the Annacis Industrial Estate. More than thirty companies are settled on Annacis, and a second development area is proceeding. Western Copper Mills Ltd., will occupy a new plant there in 1958.

Terminal No. 15, Toronto Harbour.

(Canadian Developments continued on page 112)

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

Life Members Activities

The Life Members Committee continues to be active in the affairs of the Institute and in particular in those related to students and young engineers.

Mr. E. V. Gage has been made chairman of the committee, replacing C. M. McKergow who died in 1957.

At its latest meeting, the committee appropriated approximately $1,500 of its funds to assist the Institute in several of its projects. The following is a short description of the purpose for which the funds have been given and the amounts made available in each case.

1) In order to assist in the distribution of the Institute's publication "Daylight through the Mountain" and to make certain that the universities and the branches are aware of it, 125 copies have been purchased by the committee for distribution by Headquarters.
2) In view of the extra cost of the Students Conference in 1957, the committee made $500 available to the Institute to assist in meeting the extra cost.
3) For many years the Institute has been giving to each university an E.I.C. student prize consisting of $25 in cash and an engraved certificate. The committee agreed to make an additional $25 available to apply to the prize for 1958.

There are now 809 life members in the Institute and each year through their committee they make a canvass to raise funds to assist in projects which will be helpful to the young engineers.

Secretary of the committee is John Freeland and correspondence may be addressed to him through the Institute Headquarters.

Canadian Commission for Unesco

At the first meeting of the Canadian National Commission for Unesco held in Ottawa, February 5-6, 1958, the constitution of the new Commission was presented, the roster of officers was filled, applications for membership were treated, and future work of the Commission was discussed.

The Commission has been organized by the Canada Council, at the request of the Governor General in Council (dated June 1957), in conformity with the constitution of Unesco (United Nations Educational, Scientific, and Cultural Organization).

The Canada Council provides the secretariat, and is the channel of communication between the National Commission and the Department of External Affairs. Functions of the National Commission are:

(a) to assist The Canada Council in advising the Department of External Affairs on matters relating to Unesco;
(b) to serve as an agency of liaison with organizations, institutions and individuals in Canada interested in the activities of Unesco, with Unesco Secretariat and the National Commission or other co-operating agencies of Member States;
(c) to promote an understanding of the general objectives of Unesco on the part of the people of Canada and facilitate Canadian participation in Unesco affairs;
(d) to assist The Canada Council in the execution of its program of external relations.

Members, of the Commission are three representatives of the Canada Council and one of the Department of External Affairs; the associate director of the Canada Council, and 12 members from designated agencies. Co-operating bodies supply some members of the Commission by election, 9 officers of the total of 26 being derived from this source. The E.I.C. was named a co-operating body at the first meeting, and as such will be consulted by the Commission on all matters relating to engineering in Canada insofar as the commission may be concerned.

President of the Commission is Dr. N. A. M. MacKenzie, president of the University of British Columbia who heads the executive committee. Advisory committees may be formed corresponding approximately to program sections of Unesco.

The Secretary, Eugene Bussière, reporting to the meeting on a trip to Unesco headquarters in Paris, said of the natural sciences department of the Unesco work:

"The program of this department and its methods of operation seem in all respects to meet the standards which normally can be expected from an Organization such as Unesco. Instead of spreading its funds and efforts amongst scattered projects, Unesco calls upon specific and qualified international non-governmental organizations to carry out its projects and relies on consultative committees for the formulation of its program.

"In this respect, I am glad to note that the National Research Council of Canada will be represented by its President, Dr. E. W. R. Steacie, on the Unesco International Advisory Committee on Research in the Natural Sciences at its next meeting in Moscow in 1958. Furthermore, Unesco is playing here an essential role of co-ordination in a field where international co-operation is the necessary and logical outcome to the development of science."

Southern Ontario Regional Conference

The first E.I.C. regional technical conference of its kind, was held in Hamilton, Ont., on March 15, 1958. Most noticeable and welcome evidence of success was the keen interest and enthusiasm of approximately 400 engineers and their ladies who supported the Hamilton venture.

The Hamilton Branch undertook the experiment in this new form of activity within the Institute, with the co-operation of six other branches, the Border Cities, Kitchener, London, Niagara Peninsula, Sarnia and Toronto Branches. The support and practical help of the Engineering Institute Headquarters was assured in advance.

This type of meeting was specially applicable to the Southern Ontario region, with its concentration of engineers. All engineers were invited, whether members of the E.I.C. or of the Association of Professional Engineers of Ontario.

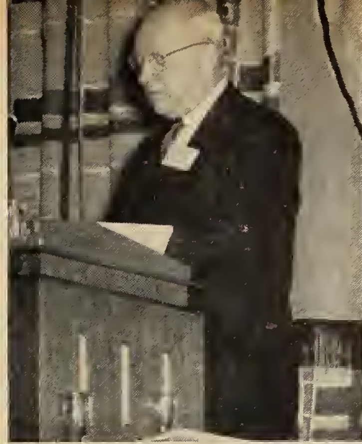
The ladies particularly enjoyed the special luncheon and afternoon fashion show arranged by the Hamilton Branch Auxiliary.

The four technical papers on the one-day program covered technical subjects of interest to all branches of engineering. Guest speakers Dr. J. A. Ouimet and Mr. J. Lance Rumble proved exceptionally interesting and found an attentive and appreciative audience.

The favourable reaction and comments received during and after the conference would encourage future endeavours of this kind, not only in Southern Ontario but in other regions of Canada.

In the small groups above and below: V. A. McKillop, past president, E.I.C., London, F. W. Roberts, Toronto, T. M. Medland, A.P.E.O., Toronto; C. Climo, D. A. Barnum and C. B. Beamer, Niagara Falls; A. F. Barnard, Hamilton, J. A. McLaren, E.I.C., Toronto, G. Norton, Toronto, H. E. Seely, Hamilton; Branch chairmen R. H. Self, Toronto, R. C. Mitchell, Hamilton, C. A. Leicht, Kitchener, E. C. Little, Niagara Peninsula.

The speakers: J. Lance Rumble (left); and N. A. Eager, H. R. Chipman, H. F. Burns, F. R. Denham. Speaker J. A. Ouimet was not photographed, regrettably.



Below: E. G. Jorgensen, Toronto, with W. A. Wheten and B. Spence of Hamilton.

Southern Ontario Regional Conference

by J. R. CURRIE, M.E.I.C., *Branch News Editor*

The first E.I.C. Southern Ontario Regional Conference was held on March 15 at the Royal Connaught Hotel in Hamilton.

Following registration and a buffet luncheon, members and guests were welcomed by Conference Chairman R. H. Stevenson who introduced the guest speaker, Dr. J. A. Ouimet, B.E., D.Sc., M.E.I.C., general manager of Canadian Broadcasting Corporation.

Dr. Ouimet, speaking on "The Impact of T.V. on Canadian Life To-day and To-morrow", described the early development of T.V. in Canada and indicated the extremely rapid growth of T.V. in this country. Results of polls taken in Canada show that T.V. viewing to-day is the third major activity of the average Canadian, exceeded only by sleep and work. The particular problems peculiar to the Canadian geography and the use of the two languages have played a dominant role in C.B.C. policy and decisions. The Canadian micro wave set-up, now nearing completion, will extend across 4,200 miles and six time zones. Dr. Ouimet concluded his address with a discussion of the need for the development of a truly Canadian pattern of T.V. productions.

Following Dr. Ouimet's address, four technical papers were presented as follows:

F. R. Denham, B.SC., PHD., M.E.I.C., of the Electro-Metallurgical Company of Canada Limited, presented a paper entitled "Heat wave". N. A. Eager, B.SC.,M.E.I.C., of Burlington Steel Company Limited, spoke on "Rail Steel as a Medium for Reinforcing Concrete". H. F. Burns, B.SC., M.E.I.C., of A. D. Margison & Associates Limited, presented a paper entitled "The Engineering Approach to Municipal Traffic Problems". H. R. Chipman, B.SC., of Naugatuck Chemicals Limited, presented a paper, "Engineering Applications of Reinforced Plastics".

During the afternoon, the Hamilton Branch E.I.C. Auxiliary and Wives of Professional Engineers entertained the ladies with a luncheon and a special Spring Revue held at the Westinghouse Auditorium.

Following the presentation of the technical papers, the Hamilton Branch entertained the delegates and their ladies at a reception held in the Sheraton Room. The reception was followed by the Conference Banquet at which the guest speaker was J. Lance Rumble, general manager of the G.M.C. Toronto Retail Truck Branch. The banquet was followed by the conference ball, with music by Chris. Lovett and his orchestra.

New Dimensions in Post-Graduate Education for the Young Engineer*

Ralph W. Rawson
Chief Engineer
Fansteel Metallurgical Corporation, North Chicago, Ill.

My remarks should be considered as four paragraphs. With my first deep breath, I will describe Fansteel Metallurgical Corporation. Next, I will discuss the nature of our engineering requirements. The topic sentence of paragraph three will be: Fansteel develops an adequate reserve of engineering manpower. Finally, I will submit for your consideration, three dimensions of engineering education as I read them.

Fansteel Metallurgical Corporation is a fifty year old company dedicated to the extraction, fabrication and sale of refractory metals. We are currently marketing tantalum, columbium, molybdenum and tungsten as oxides, carbides, powdered metal, sheet, bar, wire and fabricated parts. Our operations involve many technical fields.

Three of the twelve top Fansteel executives are Ph.D.'s, one in Chemistry, one in Metallurgy and one in Physics. The technical staff, that is, Research, Development and Engineering, consists of seventy scientists and engineers. Five have Ph.D.'s, sixteen

Ralph W. Rawson

(or about one quarter) have advanced degrees. The Fansteel technical staff includes mechanical, electrical, aeronautical, metallurgical and chemical engineers, chemists, physicists, mathematicians, theoretical metallurgists and others. In production departments we have one Ph.D., two Master degrees, thirteen Bachelor of Science degrees. Eighty percent of our salesmen have graduated from college. One conclusion, which I drew during my analysis of individual backgrounds, is that chance more than choice determines the destiny of engineers. It's a slim thread that guides us in and out of companies, causes us to specialize in sales, design, maintenance, production, industrial relations, advertising or management. If this conclusion is correct, and Fansteel is a representative population, each of you, in retrospection, will agree that your professional careers have been influenced by some of the following: your wife's choice of climate, your children's education, somebody's health, a real estate deal or a friend who misled you. All of these things happened to you after you left college. Assuming that you are forty years old, less than a third of you are working in your college specialty. If you were at Fansteel, the majority of you would have changed your specialty twice since leaving school. If you accept these findings, you will agree with me later when I say, generalize the engineering education.

As I promised, the topic sentence of paragraph three is, Fansteel develops an adequate reserve of engineering manpower. Two years ago, Mr. John Meade, our vice-president and director of industrial relations, conceived an operation known to us as the Engineering Aide Program. It has received considerable publicity in Chicago papers and may have already come to your attention. We are augmenting our engineering staff by training and utilizing technicians. A dozen young men, three of whom were already employed by us were selected from seventy applicants. Each candidate was required to be less than twenty-seven years of age and have completed his military service. The trainees were selected after an analysis of their academic records, intelligence and mechanical aptitude tests and interviews. Eight of the twelve are in their second year of chemistry, physics, mathematics, and English at Lake Forest College. Twelve more employee-students were matriculated at Lake Forest College this summer. Each man works thirty hours per week in addition to his studies. The company pays tuition, books, laboratory fees and nominal wages. The Engineering Aide Program will yield outstanding technicians at the end of two years. Further study will be allowed for those who want to continue toward a degree. Approximately *six years* will be required to complete the engineering curriculum.

Art and Science — Dr. Joseph C. Elgin, Dean, School of Engineering, Princeton University, in discussing *Trends in Engineering Education*, distinguished between *engineering art* and *engineering science*. "The engineering art", he states, deals with *know-how* and specialized techniques, with specific manufacturing processes, products, types of equipment and kinds of material and machines . . . The *art* looks to the past, and builds on past knowledge and technology, much of which may have found its way into engineering handbooks. On the other hand, the *engineering science* thinks in terms of principles and *know-why*. It attempts to generalize in order to predict the future. It deals with mechanisms by which and the reasons for, and with the principles for designing, building or operating machines, chemical processes or products of any variety. It deals with fluids or solids of any description — not restricting itself to a particular fluid such as gasoline . . ."

Our Engineering Aides at the end of two years will have *"know-how"* which constitutes *engineering art* and a considerable amount of the *"know-why"* of *engineering science*. Referring now to our development of engineers, we have arrangements with both Northwestern University and the Illinois Institute of Technology to participate in their co-operative engineering programs. The graduate engineers, whom we recruit, are selected on the basis of academic standing, extra-curricular record, motivation and

*This was Mr. Rawson's contribution to a session of the joint assembly of The Engineers' Joint Council and The Engineers' Council for Professional Development, October 25, 1957. Mr. Rawson dealt with "Development of In-Plant Training".

enthusiasm. Our recruiting is simplified by providing summer employment each year for thirty to forty engineering students who live in our locality. We prefer a man who has partially supported himself during his college career. In our opinion, the attributes of character most important in an engineer are intellectual honesty, patience, imagination, courage and perseverence. Fansteel employees who have degrees are encouraged to continue their post-graduate studies at a school of their choice. Lake Forest College, Illinois Institute of Technology, Northwestern, University of Chicago and the University of Wisconsin are available. Tuition and books are paid for by Fansteel provided a satisfactory grade is earned and the subject is related to their employment. Forty employees are taking advantage of this opportunity this year. Several men have obtained Masters degrees in this way and one Chemist is in the final stage of obtaining a Ph.D. These men are well qualified in the "know-why" of *engineering science.* Our post-graduate program also includes a curriculum at Lake Forest College known as the Industrial Management Institute. Selected employees with three years or more at Fansteel meet at the college one night each week for four years to study and discuss management problems with professors and successful executives. Several other corporations in our area participate as co-sponsors of this Institute. The Industrial Management Institute emphasizes the humanities more than the technicalities of engineering and develops leadership and managership more than professionalism. Fansteel has also sent selected supervisors to Harvard Business School and the University of Chicago for special training in management and business. Our post-graduates are combining the *"know-how"* and *"know-why"* of engineering with managerial experience and acumen.

The easiest way I could think of to cue myself for my paragraph four remarks about the Dimensions in Post-Graduate Education was to hypothesize on the length, breadth, and depth of engineering curriculums.

Concerning length: The trend toward five year courses of instruction for bachelor degrees in engineering is detrimental to the profession and not in the best interests of the individual. The engineering profession needs practical, realistic, objective, as well as intelligent young men. These characteristics are less prevalent among the "silver spoon" class who have $10,000 to invest in five years of college. The practical man won't go deeply in debt and will choose another career. The realist wonders whether or not a five year degree will increase his initial rate of compensation or merely postpone it one year. The objective man is apt also to be a utilitarian who grows impatient with unused knowledge. The intelligence level required by engineering schools insures the success of practical, realistic, objective, young engineering students in almost any other line they may choose to follow.

Concerning breadth: Continuation of this trend may lower the caliber of young engineers. The trend toward broadening the undergraduate engineering curriculum has been limited to the inclusion of humanities. Generalization of the undergraduate scientific courses is also in order. I suggest that we teach more principles of electricity, vibration and heat transfer and less induction motors, bridge construction and petroleum cracking. Since few of us are supporting our families on our college speciality, why not let industry and post-graduate schools train the engineering specialists?

Concerning depth: Depth, in terms of years of study and practical experience, is essential to individual engineers and to engineering departments. My suggestion that the undergraduate curriculum be limited to four years does not mean that the total years of scientific study should be lessened. Depth does not necessarily mean advanced degrees. By my standards, a man with a bachelor of science degree in electrical engineering and a bachelor of science degree in mechanical engineering has more depth than the man with a masters degree in either. Companies like Fansteel are making it easy for you and me to return to college for graduate work because they recognize that we are more valuable to the company after further education. As the *art* and *science* of engineering continues to grow, so will the need for post-graduate engineers. Get modern! Get more degrees!!

Canadian Conference on Education

The Engineering Institute was one of the 19 sponsoring organizations of the Canadian Conference on Education. The Institute made a considerable contribution to the conference held in Ottawa, February 17-20, 1958, which attracted great public attention.

E.I.C. delegates were Professor L. P. Bonneau, Laval University, Quebec City; Dean H. G. Conn, Queen's University, Kingston; M. J. McAuliffe; Canadian Westinghouse, Hamilton; Dean R. R. McLaughlin, University of Toronto; and Dr. Garnet T. Page, deputy general secretary, E.I.C. Unfortunately, Dean Conn was unable to attend because of illness. Two other members of the Institute, Dean H. G. Gunning, of the University of British Columbia, and Mr. P. M. Hopkins, of Aluminum Company of Canada, Kitimat, B.C., attended as delegates of other groups.

The Institute's representatives participated actively in the workshops on Higher Education, Curricula, School Buildings and Equipment, and Teachers: Quality and Quantity.

The thirty resolutions passed by the conference were all constructive and should result in useful action being taken toward solving some of Canada's most pressing problems in education.

One particular motion, recommending to the Privy Council of Canada the appointment of a national committee to examine the development of a national policy for the promotion of basic research, particularly at universities, was of special interest to the Institute. This motion developed from a suggestion originally put forward by several members of the staff of the University of British Columbia. It is understood that a number of national organizations including the E.I.C. have been asked to support the original suggestion emanating from the University of British Columbia, and the Institute will meet with representives of other national technical societies to discuss the full implications of both the original suggestion and the motion as finally passed by the Canadian Conference on Education.

The Conference appeared to have been successful in increasing public awareness of Canada's problems in education, in bringing together those concerned with these problems, in stating what some of the basic problems are, and in the establishment of a continuing organization to sponsor constructive action toward the solution of these problems.

Here are a few informal comments on the conference received from the E.I.C. participants.

"All in all I believe the Conference had a very good influence in bringing once again to the attention of the public the problem of education, and that on a national scale. It also was beneficial in bringing together a good cross-section of the Canadian educators of every level. They found out that they have many things in common and that their differences of opinion are slight in most cases."

"I attended the sessions on Organization and Curricula. The outstanding feature of the discussions in this part of the conference as I saw it, was the conclusion that we must stress the basic and traditional subjects of reading, writing and arithmetic. There has been a tendency in recent years to try to make education too easy, to think of everything as fun, and to shy away from the hard work of instilling a thorough mastery of the fundamental tools of learning in the early years of schooling."

"We must get down to first principles and recognize the primary role of the school as the academic and intellectual development of the child. If we do this properly most of the other great ideals we seek will come as a natural corollary."

"I thought the Conference a marked success. This was partly because of the 'spontaneous' gathering of so many representatives of widely different organizations and the opportunity that this afforded for interchange of views. It was good, certainly, that university people could meet with and learn to appreciate more of the problems of the public schools and their representatives. I found all these people, whether they were teachers, inspectors, representatives of labour, school boards, or industry, most friendly and co-operative and I hope they found the representatives of the universities the same way."

Correspondence

Publication of Colonel Grant's letter below was delayed for lack of space. However, a word from Col. Grant is always a pleasure, and so it is published now. Editor.

Field Secretary Retires

Dear Dr. Wright,

On leaving the position of field secretary of the Institute, which I have held for the last eight years, I feel it incumbent upon me to express my deep appreciation of the support that I have had from the eight Councils under which I have served, and for the liberality with which they have treated me.

I also wish to record my gratitude for wise direction and encouragement from yourself, for ready and efficient help from Miss McLaren and the staff at Headquarters, and for loyal and devoted service by my two assistants in Toronto, at first Mrs. Wardle, and latterly Mrs. Robertson.

Any success attained for the Institute by the field secretary's office has been due much more to those mentioned in the foregoing paragraphs than to my own efforts.

I also have to express my thanks to the chairmen, secretaries and other members of the executives of the branches of the Institute, and to many individual members who have given me help, advice and co-operation.

L. F. GRANT, HON. M.E.I.C.
Kingston, Ontario.
December, 1957.

Fourth Nuclear Congress, 1958

The 1958 Nuclear Congress concluded on March 21st, after five days of meetings in Chicago, Ill. These congresses have as their aims to (1) foster a free exchange of knowledge, information, and ideas — among engineers and scientists in all fields of technology, — among leaders in industry and management, — among management, engineers and scientists; (2) reduce the demands on the time of individuals; (3) bring into one meeting the latest information and exhibits from all fields of nuclear science, engineering and management; (4) implement the utilization of atomic energy for industrial purposes.

The Congress included the Fourth Nuclear Engineering and Science Conference, the Atomic Energy Management Conference, the 6th Hot Laboratories and Equipment Conference, and the Atomfair.

The Engineering Institute is one of the thirty societies sponsoring the Congress. Dean H. G. Conn of Queen's University, Kingston, was the Institute representative at the "All-congress Banquet". On this occasion the speaker was Vice-President Nixon of the United States. The E.I.C. was represented at these meetings, also, by the deputy general secretary, Garnet T. Page.

Sponsorship entails collaboration in the program of the Congress and in advance publicity and promotion. Through the agency of the E.I.C., three papers were presented by personnel of Atomic Energy of Canada Limited. They were: — "The Nitrate Complexes of Tetravalent Plutonium," by J. A. Brothers, R. G. Hart, and W. G. Mathers; "Kinetic Effects in the Partitioning of Uranium and Plutonium in the Processing of Irradiated Reactor Fuels by Extraction with Tributyl Phosphate," by W. W. Morgan, W. G. Mathers, and R. G. Hart; "The Behavior of Ruthenium in the Fixation of Fission Products", by W. E. Erlebach and R. W. Durham.

Space does not permit the listing here of the 214 original papers presented relating to this year's theme, "Industrializing the Atom".

Copies of many of the papers are still available in the form of preprints. A list of the preprints available is in the E.I.C. Library; or it can be obtained from the American Institute of Chemical Engineers, 25 West 45th Street, New York 36, New York.

DATES TO REMEMBER

AUGUST 11, 12, 13, 1959

NOVA SCOTIA TECHNICAL COLLEGE

50th Anniversary Reunion

For information write Box 811, Halifax, N.S.

THIRTY-FIVE YEARS AGO

Comment on the Journal of May, 1923

Three papers were published in the May 1923 issue: the first by W. Nelson Smith, M.E.I.C., consulting electrical engineer, Winnipeg Electric Co., entitled The Principles of Three Wire Distribution for Electric Railways. Though of wide interest at the time, the subject has lost much of its interest today.

The second paper, by G. F. Blair, K.C., city solicitor of Regina, dealt with important points relative to specifications for building contracts, and covered many aspects of specifications that are true today.

A third paper, entitled Electrons, Atoms and the Ether by W. B. Cartmel, M.E.I.C., of Northern Electric, was continued from the April issue.

Editorially, plans were announced for the first meeting in Montreal of the American Society of Mechanical Engineers, to be held jointly with the Engineering Institute of Canada.

A cross-section of 'News of the Branches' for the month reveals the subjects which were of interest in the twenties. The Victoria Branch reported on a visit of members to the plant of the Victoria Gas Company, a new up to date plant for producing manufactured gas. The Calgary Branch heard two papers on street railways.

The London Branch reported on two papers, one on rural roads in the Province of Ontario, the second on The Mechanical Engineer of Today. At a third meeting, General Secretary Fraser S. Keith stated that there were then twenty-three branches with a total membership of 5,300.

The Toronto Branch had a luncheon meeting on April 19 to do honor to President-Elect Walter J. Francis, with some 150 members in attendance including C. R. Young, Dr. R. A. Ross, General C. H. Mitchell, C. H. Rust, Frederick B. Brown, M. J. Butler, Willis Chipman.

The Hamilton Branch had listened to an address on Power Developments in Japan, by Stephen Q. Hayes of the Westinghouse Co. of Pittsburgh. At the Niagara Branch, members attending a dinner meeting heard an address by Hew M. Scott, M.E.I.C., on the Esquimalt Dry Dock and on the Ravages of Marine Pests on the Pacific Coast. Street Lighting was the subject treated at a meeting of the Peterborough Branch, by R. C. Flitton, M.E.I.C.

At Ottawa, W. Kynoch, F.R.S.A., of the Forest Products Laboratory addressed a meeting on Wood and its Possibilities and Commander C. P. Edwards of the Dept. Marine and Fisheries spoke on Wireless Telephony.

The Quebec Branch report covered seven addresses and papers. Julian C. Smith, M.E.I.C., had given a lecture on Recent Advances in Water Wheel Design. P. A. Galarneau, general manager, Citadel Brick Co. had presented an address on the Making of Brick Throughout the Ages.

S. L. DeCarteret, A.M.E.I.C., had spoken on The Manufacture of Wood Pulp. Avila Bedard, director of the Quebec Forestry School had reviewed the forest situation in the Province of Quebec and the extent and effect of various destructive agents.

Professor Augustin Frigon, M.E.I.C. of Ecole Polytechnique at a luncheon meeting had attempted to interest engineers in research work, both scientific and industrial. Finally, E.I.C. General Secretary, Fraser S. Keith, had reviewed the history of the profession.

The Moncton Branch heard a talk by W. B. MacKenzie, M.E.I.C. on the City of Halifax and its harbour, bringing to light some historical data and many scientific facts. The speaker felt the proper site had not been selected for the city and docks.

Three meetings were reported from the Cape Breton Branch at Sydney, N.S. John T. Farmer, M.E.I.C., chairman of the Montreal Branch, gave an address on Mechanical Stokers. K. G. Cameron, A.M.E.I.C., of the Dominion Coal Corporation was guest of honour at a special dinner meeting on the eve of his departure for Montreal. E. C. Tonge, A.M.E.I.C., addressed the regular meeting on the subject of Coke Manufacture with By-Product Recovery.

In an open letter signed by Willis Chipman, M.E.I.C., president of the Association of Professional Engineers of Ontario, members of the Engineering Institute of Canada resident in Ontario, were urged to register and apply for membership.

H. G. C.

Nuclear Congress, 1959

Canadians Invited to Present Papers in Nuclear Field

The Fifth Nuclear Congress is scheduled for April 5-10, 1959 in Cleveland, Ohio.

The Engineering Institute of Canada, as a participating society, will provide for the Nuclear Engineering and Science Conference one or more technical papers. Authors are invited to submit summaries (300-500 words) of proposed papers. Summaries should be received at Headquarters by October 1, for transmission to the Congress Manager.

Authors will be notified in October of the selection of papers for the program, and will be given specifications for the preparation of manuscripts, to be received by the E.I.C. by November 28.

Interested authors should send summaries to: Dr. Garnet T. Page, The Engineering Institute of Canada, 2050 Mansfield St., Montreal 2, Que.

MARITIME PROFESSIONAL ENGINEERS CONFERENCE

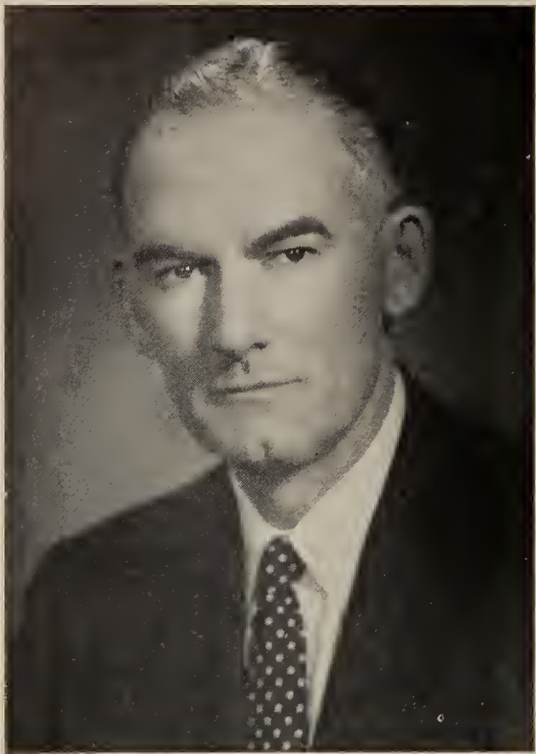
of the Engineering Institute of Canada, Atlantic Provinces Branches, and the Associations of Professional Engineers of Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland.

This important meeting will be held on

September 2-5, 1958

at

Digby Pines, Digby, N.S.



K. F. Tupper, O.B.E.

PRESIDENT

The Engineering Institute of Canada

1958 - 1959

THIS YEAR the Engineering Institute of Canada elected as its head, a man with wide experience in the field of atomic energy. He is K. F. Tupper, president of the firm of Ewbank and Partners (Canada) Limited. Located at Toronto, this is a firm of engineering consultants in the field of thermal and electrical power.

Mr. Tupper grew up in Western Canada; taking his elementary and secondary education in Saskatoon and Calgary. He went on to engineering studies at the University of Toronto where he won a B.A.Sc. degree in mechanical engineering in 1929. He subsequently studied aeronautical engineering at the University of Michigan, receiving a M.Sc. degree in 1938.

What was to develop into an eventful engineering career began at the Riverside Iron Works Limited, Calgary in 1929. Later that year he joined the National Research Council, physics department as a draughtsman. Subsequently the division of mechanical engineering was formed and the aeronautical laboratories became a part of it. He was concerned with the design and operation of wind tunnels and the ship model testing basin.

In 1943, Mr. Tupper was assigned to the Canadian aircraft jet engine project. Emerging from this project a Crown company, called Turbo Research Limited was formed in which he became chief engineer. A forerunner of the Aircraft Gas Turbine Division of A. V. Roe, Canada Limited at Malton, Ont., it subsequently became Orenda Engines Limited. In 1946 when the project passed from Turbo Research to A. V. Roe, Mr. Tupper returned to the National Research Council. He was assigned to the atomic energy project at Chalk River, Ont. In 1947, he was appointed director to take charge of the division responsible for plant operations and services.

In 1949 the University of Toronto conferred on him the office of fifth dean of the faculty of applied science and engineering. However, he retired in 1954 in order to devote his time to the firm with which he is now associated.

In recognition of his wartime services he was awarded an O.B.E

Mr. Tupper was in 1957 elected to serve a three-year term as councillor of the Institute representing the Toronto Branch.

NEWLY ELECTED OFFICERS OF THE INSTITUTE

At the Annual Meeting, three vice-presidents and twenty-five councillors will take office, and will serve with others whose terms of office continue. The complete list of Council Members will appear in the June issue.

THE MARITIME PROVINCES

John Bartlett Angel, M.E.I.C., president of the United Nail and Foundry Company Limited, St. John's Newfoundland, and charter member of the Newfoundland Branch, has been elected a vice-president of Zone D of the Institute, which encompasses the Maritime provinces.

Mr. Angel attended the Memorial University of Newfoundland and McGill University. He received a B.Eng degree in metallurgy in 1935 from the latter institution.

Mr. Angel is among those fortunate few who have travelled extensively in the Arctic. Between 1931 and 1935 he was privileged to visit Greenland several times. Together with Captain Robert A. Bartlett he went to Foxe Basin in 1933.

He joined the United Nail and Foundry Company Limited in 1935 as an engineer, became managing director in 1938 and president in 1948.

Mr. Angel is president of Wm. Noseworthy Limited, St. John's, and the Angel Manufacturing and Supply Company Limited, of North Sydney, N.S. He is chairman of Heap and Partners (Nfld) Ltd. and director of the Newfoundland Fire and General Insurance Company and Majestic Sales Limited, at St. John's. He is a past-president of the Newfoundland Board of Trade.

Michael R. Campbell, M.E.I.C., 1955 chairman of the Cape Breton Branch will serve a two-year term as councillor of the Institute. Mr. Campbell is assistant general superintendent of Dominion Iron and Steel Limited, Sydney, N.S.

A graduate of St. Francis Xavier University and the Massachusetts Institute of Technology, he gained an M.Sc. degree in chemical engineering from M.I.T. in 1927.

Joining Dosco at that time, he was almost immediately named assistant superintendent of the open hearth department.

Late in 1932 he was granted a leave of absence to become head of the chemistry department at St. Francis Xavier University, and returned to the Sydney steel plant in 1934. Appointed superintendent of the open hearth department in 1946, his promotion to assistant general superintendent of Dominion Iron and Steel Limited dates to 1953.

William S. Hosking, M.E.I.C. of the Northern New Brunswick Branch, E.I.C., steam plant superintendent of the Bathurst Power and Paper Company Limited, Bathurst, N.B., has been chosen a councillor of the Institute to serve a two-year term. Mr. Hosking held office as chairman of the Branch in 1955.

A Queen's graduate, class of 1931, in mechanical engineering, he has been continuously employed with the Bathurst Company since that time.

He is a member of the Institute of Power Engineers, and a member and former chairman of the technical section, Canadian Pulp and Paper Association, Atlantic Branch.

Robert S. Morrow, M.E.I.C., of the North Nova Scotia Branch, newly elected councillor of the Institute who will represent that Branch for a two year term, is associated with the power shovel department of the Maritime Steel and Foundries Limited, at New Glasgow, N.S. He previously served as a member of the Branch executive.

After several years service with the R.C.A.F., Mr. Morrow attended Mount Allison University, from which institution he was granted a B.Eng. degree in mechanical engineering in 1950. He joined his present employer at that time.

A. W. Purdy, M.E.I.C., of Moncton, N.B., district sales manager for the Maritime neers of Quebec, the Montreal Section Quebec section of the E.I.C., and past-Cement Company Limited has been elected a councillor of the Institute to serve a two year term of office. Mr. Purdy has been active in the affairs of the Institute as chairman of the Moncton Branch in 1955.

A 1949 graduate of the University of Queen's with a B.Sc. degree in civil engineering following a three year period of army service, he became associated with the Canada Cement Company Limited, Toronto, on graduation. Two years later named district sales manager of the Maritime Cement Company Limited at Moncton, he has held the position to the present time.

He is vice-president of the Canadian Construction Association for N.B. and P.E.I.

Gilbert F. Vail, M.E.I.C., associate professor, department of electrical engineering at the Nova Scotia Technical College, Halifax, has been elected councillor of the Halifax Branch of the Institute to serve a two-year term.

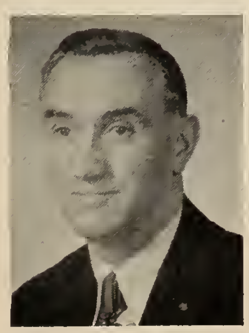
Mr. Vail graduated from Dalhousie University and the Nova Scotia Technical College 1943, with a B.Eng. degree, in electrical engineering. Immediately he joined the Royal Canadian Navy as an electrical officer in 1943.

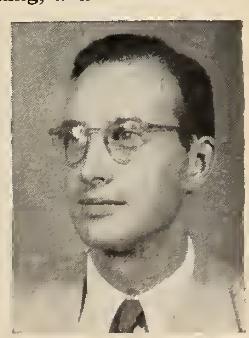
Professor Vail became a lecturer in electrical engineering at the University of Toronto in 1946. In addition to lecturing duties he carried on research and advanced studies leading to an M.Sc. degree in electrical engineering, received in 1948. He was named to an associate professorship at this point in his career at N.S.T.C. Recently he has availed himself of leave of absence for special study at the University of Michigan, 1956-57.

Recipient of two special awards, these were the Queen's Coronation Medal and the Canadian Forces' Decoration presented in 1955.

Professor Vail holds the rank of Commander in the Naval Reserves and is

Shown left to right are Maritimes vice-president J. B. Angel, and four of the five councillors elected, M. R. Campbell, A. W. Purdy, W. S. Hosking, and R. S. Morrow.

a commanding officer of the Halifax universities naval training division.

In addition to past service as an executive of the Halifax Branch he is a past chairman of the professional development committee and of the student members' committee.

QUEBEC

Edward T. Buchanan, M.E.I.C., division manager of the Laurentide division of Consolidated Paper Corporation, Grand' mere, Que., has been elected a vice-president of the Institute, representing Zone C, or the Province of Quebec. Mr. Buchanan has given former Institute service as branch chairman and as a councillor representing the St. Maurice Valley Branch of the Institute in 1955.

An electrical engineering graduate of McGill University, class of 1928, Mr. Buchanan has been associated with the pulp and paper industry since 1935. At that time associated with the Corporation in the field of accounting, he was promoted to assistant chief engineer in 1946, to chief engineer in 1953 and division manager of the Laurentide division of the organization in November 1956.

Mr. Buchanan was granted the I. H. Weldon Medal of the technical section of the Canadian Pulp and Paper Association in 1948.

Ben O. Baker, M.E.I.C., has been elected to a two year term of office as councillor of the Institute representing the Quebec Branch. Having completed terms as vice-chairman and chairman of the Branch, his new position of councillor also brings with it a chairmanship of the 1958 annual meeting committee of the Institute.

Graduating with a B.Sc., electrical, from the University of Manitoba in 1940, Mr. Baker joined the Canadian General Electric Company at that time. He completed the test course and entered the engineering department at Peterborough. With Genelco Ltd., armament manufacturing division, in 1941, he was loaned to the Government of Canada in 1943-44 and underwent armament design training in England. He joined the Canadian Armament Research and Development Establishment in 1946, which became part of the Defence Research Board upon its foundation in 1947. He became deputy superintendent, then superintendent of the design wing at C.A.R.D.E.

Mr. Baker is the Defence Research Board representative for mechanical engineering and drafting on committees of the Canadian Standards Association and the Canadian Government Specifications Board.

E. D. Gray-Donald, M.E.I.C., elected a councillor of the Institute, representing the Montreal Branch for a three year term, was previously chosen for this office in 1953. He was the 1956 choice as chairman. He served the Quebec Branch as councillor in 1942 and 1948, as chairman in 1944-45.

Mr. Gray-Donald is the vice-president, administrative services, for Shawinigan Water and Power Company, Montreal; vice-president and director, Quebec Power Company, Quebec City, and a director of the Montreal City and District Savings Bank.

With an earlier background of general engineering experience in Palestine and in London, England, he graduated from McGill University with a B.Sc. degree in 1926, an M. ès Sc. at Laval in 1934.

His career with the Shawinigan Water and Power Company dates to the time of his first degree. Transferred to the Quebec Power Company in 1927, he filled various positions until in 1937 he was appointed general superintendent of the Quebec Power Company and the Quebec Railway Light and Power Company. He was appointed chief engineer for both companies in 1942. Appointed vice-president and chief engineer of the Shawinigan Water and Power Company in 1950; vice-president, personnel and public relations in 1954; he was named to his present post in 1957.

J. E. Leo Roy, M.E.I.C., general manager of the Quebec Hydro-Electric Commission is a newly elected councillor of the Institute representing the Montreal Branch for a three year term. Mr. Roy is an immediate past-president of the Corporation of Professional Engineers of Quebec, the Montreal Branch of the Institute, former secretary of the Quebec Branch of the E.I.C., and past-president of the Montreal section of the American Institute of Electrical Engineers. He is currently Canadian representative on the Ethics Committee of the Engineers' Council for Professional Development.

Mr. Roy who holds engineering degrees from L'Ecole Polytechnique, Montreal, civil, 1930, and from McGill University, B.Eng., 1932, began his professional career with the Shawinigan Water and Power Company. In 1938 he joined the Quebec Power Company as power sales engineer, transferred his services to Hydro Quebec in 1946, and the following year was named superintendent of the transmission and distribution section of the organization. Taking charge of the auxiliary services of the Commission at an executive level in 1952, as chief engineer, he was in July 1957 named general manager.

ONTARIO

Dean Hugh Gordon Conn, M.E.I.C., O.B.E., F.R.S.A., of the faculty of applied science, and professor and head of the department of mechanical engineering at Queen's University, Kingston, Ont., has been elected vice-president of Zone B of the Institute, representing the Province of Ontario. In 1955 he served as councillor of the Institute.

An Ontario-born mechanical engineer with a background of service in industry and the army, H. G. Conn was educated at Queen's University and the University of Michigan. He received a B.Sc. degree in mechanical engineering at the former institution in 1931. The American university awarded him an M.S. degree in 1946. In 1932 he joined the firm of Procter and Gamble Company Limited, at Hamilton. He returned to Queen's University as a lecturer in mechanical engineering in 1937.

Dean Conn served with the Royal Canadian Electrical and Mechanical Engineers from 1939 until the end of the war, returning to Canada in 1945.

He completed work for an M.S. degree at the University of Michigan in 1946. That fall he was appointed head of the department of mechanical engi-

Maritime councillor, Professor G. F. Vail; vice-president for Quebec, E. T. Buchanan, and the three Quebec councillors elected, J. E. L. Roy, E. D. Gray-Donald and B. O. Baker.





Ontario vice-president Dean H. G. Conn, and left to right, four of the eleven councillors elected, W. D. Adams, E. T. W. Bailey, P. E. Buss, and Colonel W. A. Capelle.

neering, at Queen's, he became dean of the faculty of applied science in 1955.

He is chairman of the Canadian Advisory Committee of the Institution of Mechanical Engineers (London).

W. D. Adams, M.E.I.C., of Sault Ste. Marie, piling engineer with the Algoma Steel Corporation Limited until his retirement in 1957, has been elected to represent the Sault Ste. Marie Branch of the Institute as councillor for a two year term.

Mr. Adams is a graduate of the Royal Military College of Canada, 1908, in civil engineering. He gained various engineering experience before enlisting in the Victoria Rifles of Canada in 1914. He served overseas, was awarded the M.C., 1917, and demobilized as a major.

Returning to Canada he became a partner of the Adams Brothers, Toronto, later joining the Toronto Transportation Commission in 1921. Subsequently he was associated with Walter J. Francis and Company of Montreal, and with A. Bentley and Sons, Toledo, Ohio. He returned to Toronto in 1925 as resident engineer with the Toronto Waterfront Viaduct. He also spent some time in Montreal with Watson Jack Company Limited as sales engineer before becoming Toronto manager of the H. E. McKeen and Company in 1935. He joined Algoma Steel in 1944.

He was chairman of the Sault Ste. Marie Branch in 1946 and in 1955.

E. T. W. Bailey, M.E.I.C., chief combustion engineer of the Steel Company of Canada, Limited, Hamilton, Ont., has been elected to represent the Hamilton Branch of the Institute as a councillor, for a two-year term. He has chalked up previous E.I.C. service as chairman of the Branch during 1951 and 1952.

Mr. Bailey attended the University of Toronto, received a B.A.Sc., degree in 1926, and a Chem.E., degree from the same institution in 1932.

The first two years of his post-graduate career were spent with the Aluminum Company of Canada Limited, at Arvida, Que. In 1928 he joined the engineering staff of the Steel Company of Canada, Limited at Hamilton.

Mr. Bailey has served as chairman of the Hamilton Chemical Association, as a director of the Association of Iron and Steel Engineers, Pittsburg, Pa.

In 1947 he was the recipient of the Plummer Medal of the Institute.

Paul E. Buss, M.E.I.C., president of Spun Rock Wools Limited, Thorold, Ont., will serve his seventh consecutive two-year term as representative of the Niagara Peninsula Branch of the Council of the Institute, in 1958-59.

A graduate of the University of Michigan with a B.Sc. degree in electrical engineering, Mr. Buss joined the engineering staff of the Provincial Paper Limited, as a plant engineer, Thorold division, after overseas service with the United States Army Engineers in World War I. He was also associated with the Dominion Engineering Works.

During 1932 and 1933, Mr. Buss and his brothers made experiments in the development of a new process for the production of rock wool by the spinning method. A direct outcome of these was the setting up of the firm Spun Rock Wools Limited, at Thorold, of which Mr. Buss is president.

Previous to his activities as councillor of the Niagara Peninsula Branch he served as its secretary-treasurer in 1931, as its chairman in 1935.

He recently retired from the Thorold Board of Trade after twenty years service as secretary-manager.

Colonel W. A. Capelle, M.E.I.C., Commander, Canadian Base Units, Middle East, formerly director of engineer development at Ottawa, has been elected a councillor of the Institute to represent the Ottawa Branch for a three-year term. It is expected that Colonel Capelle will return to Ottawa in September.

Colonel Capelle is a graduate of the University of Manitoba, 1932. He joined the R.C.E. at that time and has since followed the career which has combined engineering and a military life.

Colonel Capelle saw extensive service in World War II, retiring as senior officer with the Royal Engineers, Airfields, at headquarters, First Canadian Army in 1945. He rejoined the regular army two years later. In 1952 he was promoted to the rank of colonel and appointed director of works, A.H.Q. He was appointed director of engineer development in 1954.

E. L. Cavana, M.E.I.C., of Orillia, Ont., has been elected to represent the Huronia Branch as a councillor of the Institute for a two-year term.

Ernest L. Cavana attended the University of Toronto and graduated with a B.A.Sc. degree in civil engineering in 1920. He became an Ontario Land Surveyor in 1922. Early in his career he was employed with the Canadian National Railways, maintenance division, with the Department of Highways, Province of Ontario in engineering and construction. In 1926 he was associated with the Hydro-Electric Power Commission, in the field of hydraulic engineering.

For the greater part of his professional life Mr. Cavana has been engaged in private practice in the field of general engineering and surveying.

E. R. Davis, M.E.I.C., Toronto, consulting engineer, in private practice, has been elected to serve the Institute as a councillor for a three year term. He has given his energies to Institute service as a member of the executive committee of the Toronto Branch since 1953. He was the 1957 choice as chairman of the group.

He is also active in the work of the American Society of Mechanical Engineers.

Mr. Davis, who holds a B.Sc. electrical, from the University of Manitoba, 1936, and a B.Eng. degree, mechanical, McGill, 1937, worked with Dominion Engineering Works, Hamilton, and Canadian Controllers Ltd., Toronto in the early part of his career. Throughout the 1940's he was with the Canadian Comstock Company Limited, in Montreal, Hamilton, Halifax, rising to the post of manager, mechanical department in 1948.

Briefly associated with Margison and Babcock, consulting engineers, Toronto in 1950-1951, he set up his present consulting practice which designs power plants, mechanical and electrical, in 1952.

A. A. Kidd, M.E.I.C., will represent the North Eastern Ontario Branch of the Institute as a councillor for a two year term of office. Mr. Kidd, who resides at Cochrane, Ont., is manager of the Cochrane Public Utilities Commission.

A B.Sc. graduate in engineering physics from Queen's University, class of 1941, Mr. Kidd enlisted as a radar officer in the Royal Canadian Navy on graduation and was for most of this time on loan to the Royal Navy.

Later his experience included seven years as a mechanical and electrical project engineer with the Spruce Falls Power and Paper Company at Kapuskasing, Ont. He has been engaged in his present work for five and a half years.

He is a member and ex-director of the Association of Municipal Electrical Utilities (of Ontario).

R. A. McGeachy, M.B.E., M.E.I.C., administrative assistant to the manager of the Sarnia refinery, Imperial Oil Limited, who served the Institute as a councillor representing the Sarnia Branch in 1956-57 has been re-elected to this office, for a two year term.

Mr. McGeachy graduated from the University of Michigan in 1923 with a B.Sc. degree in civil engineering. He gained experience in railway and general construction work until 1930. Beginning his career with Imperial Oil Limited as a draughtsman, he was later transferred to the mechanical department and was engaged in construction and maintenance. In World War II, on leave of absence, he served overseas for five years with the Royal Canadian Engineers. Discharged with the rank of major, he was later awarded the M.B.E. Returning to Imperial Oil Limited, he was named zone engineer. His present post dates to 1953.

He servel the Sarnia Branch as secretary in 1954.

L. J. R. Sanders, M.E.I.C., of Galt, Ont., has been elected councillor for the Kitchener Branch of the Institute for a two year term. One of the charter members of the Branch, he became its chairman in 1955. He is president and managing director of the L. J. R. Sanders Engineering Company, Galt, Ont. The firm designs and builds special equipment.

Mr. Sanders began his training with the later Westinghouse Company in England. He graduated from Loughborough College, England, in 1923, with a degree in mechanical engineering after serving with the Royal Navy Air Service. A post-graduate course at Cornell University preceded his move to Canada in 1926. Employed first with the Tudhope Anderson, Orillia, Ont., as chief engineer, and later with Lake Shore Mines at Kirkland Lake, Ont., for the first few years, he joined the Aluminum Company of Canada in 1929 as divisional superintendent at Toronto. Later, sent to England by the organization, he supervised construction of the subsidiary plant for Northern Aluminum at Banbury. He returned to Canada in the depression days of the mid-'thirties, after four years in England.

After interim work as a consultant in machine shop and foundry practice in the United States and Canada, he joined the Algoma Steel Corporation, Sault Ste. Marie, in 1937 as superintendent of shops. In 1940 he was one of those chosen to go to England with a group from the Otis Elevator Company to study the Bofors gun.

Joining the Wartime Merchant Shipping in 1941, he was responsible for the production of the machinery and equipment for ships. Subsequently, the Bureau of Technical Personnel transferred him to Ottawa as director of naval stores.

At war's end, Mr. Sanders purchased the C. H. Smith Machine Company in Galt and founded the organization which he now heads.

Howard E. Meadd, M.E.I.C., of Cornwall, Ont., has been elected to represent the Cornwall Branch of the Institute as a councillor for a two year term. Mr. Meadd was associated with the Howard Smith Paper Mills Limited from 1925 until his retirement in 1957, and was in charge of engineering and construction for the Cornwall division of the firm.

Mr. Meadd graduated from Queen's University in 1921 following an interruption of his studies by overseas service in World War I. He worked for the Ontario Hydro-Electric Power Commission on the Cameron Falls development of the Nipigon River. Following this he spent three years with the Fort Francis Pulp and Paper Company Limited, as a design engineer, prior to joining Howard Smith.

P. F. Peele, M.E.I.C., will serve on the council of the Institute representing the Peterborough Branch for a two year term of office. This election follows previous Institute service as Branch secretary-treasurer in 1940-1941; chairman in 1945.

He is employed with the Canadian General Electric Company Limited, apparatus department, transportation sales division at Peterborough. Mr. Peele has served his company both in Eastern and Western Canada. On graduation from the University of British Columbia with a B.A.Sc. degree in electrical engineering in 1924 he joined the Canadian General Electric Company Limited through the medium of the test course at Peterborough. Later he served as sales engineer at Vancouver, apparatus manager at Calgary, before moving to the locomotive sales office of the organization at Toronto in 1951. He moved to Peterborough in 1956 when the apparatus headquarters was transferred to that point.

WESTERN PROVINCES

W. M. Berry, M.E.I.C., of Regina, Sask., chief of the hydrology division, Prairie Farm Rehabilitation Association, at Regina, Sask., has been elected to serve a two year term as a councillor for the Saskatchewan Branch of the Institute. This follows similar service in 1953-1954.

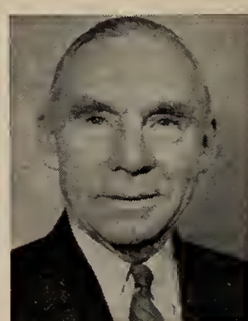
Mr. Berry is the Canadian secretary of the International Engineering Committee, set up by the International Joint Commission to study the problems of the Waterton, Belly, Souris and Red Rivers. He is also the engineering secretary of the Prairie Provinces Water Board, which duties were assigned him in 1948.

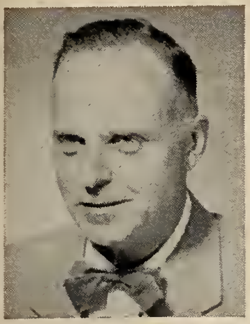
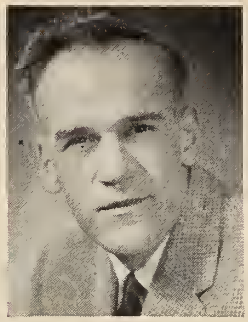
Mr. Berry holds a B.Sc. degree from the University of Manitoba, gained in 1944, an S.M. degree from the Massachusetts Institute of Technology, 1947, following studies in water resources development.

In 1947 Mr. Berry took over responsibility for hydraulic and hydrologic prob-

Five councillors representing Ontario Branches are shown: E. L. Cavana, E. R. Davis, H. E. Meadd, R. A. McGeachy and A. A. Kidd.



Two Ontario councillors appear at the left, P. F. Peele, and L. J. R. Sanders. Representing Western Canada are councillors N. M. Hall, W. M. Berry, and D. Cramer

lems in the Regina, Saskatchewan design office. His present appointment with the department of hydrology was announced in 1951.

He is a past chairman of the Regina community planning committee.

He was a councillor, 1953-1955, for the Association of Professional Engineers of Saskatchewan.

He is a member of the hydrology committee of the National Research Council.

F. M. Cazalet, M.E.I.C., of Vancouver has been elected a councillor of the Institute representing the Vancouver Branch for a two year term.

Mr. Cazalet is supervisor of mechanical engineering for the B.C. Electric Company Limited, and past chairman of the Branch, 1955.

Mr. Cazalet, whose home was originally England, received part of his education in that country and then graduated from the University of B.C. with a B.A.Sc. degree in mechanical engineering in 1937.

Joining B.C. Electric on graduation, he became supervisor of mechanical engineering following experience in the research, sales, and planning departments.

David Cramer, M.E.I.C., office engineer for the St. Mary irrigation project, Lethbridge, Alta., has been elected to serve a two-year term as councillor of the Institute. Active in the affairs of the Institute, he was secretary-treasurer of the Lethbridge Branch from 1948 to 1952, was vice-chairman for a season and in 1953 was the Branch choice for chairman. Since that time he has remained active in the Branch and has served on various committees.

Mr. Cramer is a 1944 graduate of the University of Saskatchewan in civil engineering. He joined the P.F.R.A. department of agriculture, at Regina, Sask., as a design engineer. He was transferred to Calgary in 1945 to work on the St. Mary Irrigation project, as a design engineer and the following year took part in the construction of the project, at Lethbridge. His appointment as office engineer dates to 1948.

N. M. Hall, O.B.E., M.E.I.C., has been elected a representative of the Winnipeg Branch to the Council of the Institute for a two year term. Mr. Hall is a retired professor (emeritus,) and chairman of the mechanical engineering department, University of Manitoba. He operates a consulting mechanical engineering practice in Winnipeg.

Mr. Hall attended McGill University and the London School of Economics, graduating from the former institution in 1907, with a B.Sc. degree in mechanical engineering.

Mr. Hall joined the B.E.F. during World War I and served with the Royal Engineers.

He became associated with the University of Manitoba in 1919, at which time he also set up his consulting engineering practice.

Stanley J. Hampton, M.E.I.C., 1957 chairman of the Edmonton Branch has been elected to serve a two year term as councillor of the Institute representing that branch. He is chief electrical engineer for the City of Edmonton, electric light and power distribution system.

Mr. Hampton commenced his engineering career in the electrical distribution field with the City of Edmonton in 1946 as a design engineer on the underground network system. He was promoted to chief electrical engineer in 1950.

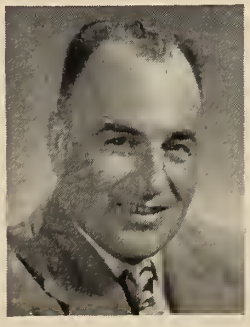
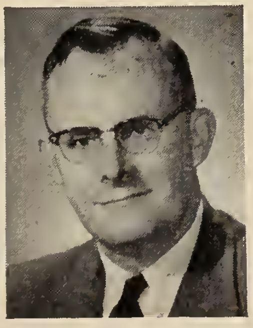
He is a graduate of the University of Alberta and holds a B.Sc. degree in electrical engineering, class of 1946.

T. D. Stanley, M.E.I.C., of Calgary, production superintendent of Calgary Power Limited, Calgary, past chairman of the Calgary Branch, 1952-1953, has been elected to serve as councillor of the Institute, representing the Calgary Branch for a two year term.

Mr. Stanley had his engineering training at the University of Alberta, graduating with a B.Sc., in arts in 1929; a B.Sc. in electrical engineering from that institution also in 1932; and a M.Eng. in electrical engineering at McGill University the following year. After following post-graduate work in electrical and civil engineering at the University of Alberta, he joined Calgary Power Limited as an apprentice engineer in 1935. Six years later he was named assistant to the production superintendent. He assumed his present responsibilities in 1942.

Mr. Stanley is a past-president of the Association of Professional Engineers of Alberta, 1955-56.

T. D. Stanley, F. M. Cazalet, and S. J. Hampton, complete the list of six Western representatives.

What Goes On

(Continued from page 98)

Investment Intentions, 1958

Plans for a total capital expenditure program in Canada in 1958 of $8.5 billions were revealed by a survey of Canadian business, institutions, governments and housebuilders, according to the Department of Trade and Commerce, Ottawa. This is close to the record $8.7 billion capital spending rate of 1957.

The Department's "Private and Public Investment in Canada — Outlook 1958" was released in March. (Queen's Printer, Ottawa.)

Within the total, construction outlays are expected to reach $5,991 millions. Outlays for acquisition of machinery and equipment are expected to total $2,530 millions.

A strong resurgence in outlays for housing and social capital largely offsets a lower level of business capital spending. Expansion is expected to continue at about the 1957 rate in secondary manufacturing, utilities, commercial building and agriculture. A lower rate of expansion is planned in resource-based industries, for mining facilities, and for plant and equipment in such manufacturing industries as paper products, iron and steel and non-ferrous metal and non-metallic mineral processing.

Substantial increases are expected in the construction of hospital and university facilities and in construction expenditures by all levels of government.

CF-105 Avro Arrow

The Avro *Arrow* flew in April at approximately 1,000 miles an hour, the R.C.A.F. reported.

In one of a series of flight tests the *Arrow* attained, in level flight, one and one-half times the speed of sound at an altitude of 50,000 feet. This significant achievement came only about a month after the first flight of the interceptor, developed by Avro Aircraft Limited, Malton, Ont.

The decision as to full production of the CF-105 for the R.C.A.F. is to come later in the year.

Road System in the North

Work has begun on a recently announced Federal Government project of roadbuilding in the Yukon and Northwest Territories. The building of 1,200 miles of roads and six major bridges will be a $31 million program.

In the Yukon a development road from the existing road system at Flat Creek, near Dawson, to Fort McPherson on the Mackenzie River is expected to be carrying traffic by 1962. This road will pass the Eagle Plain Oil Reservation, where large-scale exploration for oil is under way, and will be about 400 miles long.

The major road project in the Territories is the 550-mile Great Slave-Great Bear road. The first stage, to be completed in 1960 at a cost of $10 million, is a road going 300 miles around the west end of Great Slave Lake to join Yellowknife with the Mackenzie Highway. The second stage will be another 250 miles of road to Great Bear Lake, at an estimated cost of $5 million. Some existing roads will become part of the main development road system; the Fitzgerald-Bell Rock road will be surfaced; and a road from Peace Point to the Wood Buffalo National Park is being built. When the Province of Alberta constructs a road from North Vermilion, it will provide the first year-round communication between Fort Smith and outside points.

A $150 million plan for 50-50 federal-provincial sharing of costs of development roads in the northern areas of the four western provinces, tentatively agreed, is another prospect. The development roads will link up with the federal projects mentioned above.

Alchem Microbiological Laboratory

Alchem Limited has established at Burlington, Ont., a new Microbiological Laboratory to offer service in the control of slime and algae in the paper industry. A three point plan, the service consists of mill survey, report on basic control measures, and regular mill inspections and microbiological checks.

Lloydminster is a City

Lloydminster became a city of Saskatchewan and of Alberta in January 1958, when its status of city was established by both provinces. The city is astride the Saskatchewan-Alberta border.

Called Canada's "Black Oil Capital", Lloydminster profited by the advent of new industries following the discovery in 1943 of crude oil — asphalt companies, manufacturers of caulking compounds and wood preservatives, machine shops, as well as concrete block and pipe and welding companies. Two grain elevators have a combined capacity of 70,000 bushels.

Quebec Power Company

Substantial increases in electricity sales, in revenue and in net earnings were shown in Quebec Power Company's annual report for 1957.

Kilowatt hour sales of electricity exceeded the billion mark for the first time. The report showed total revenue up 9.7 per cent to $13,713,751.

Continuing expansion of the Company's system required capital expenditures of $2,555,622. A second 25-mile high voltage transmission line was completed from Quebec City to Beaupré; the new La Suete substation in Ste-Foy came into service; and 109.5 miles of distribution line were built in urban and rural areas.

New Blasting Technique

Canadian Industries Limited describe a new technique of submarine blasting — the Air Cushion, which is being used by McNamara Construction Co. Ltd. in the deepening of the Welland Ship Canal at Port Colborne.

The technique ends the necessity of restricting blasting operations to a distance of 14 feet from the canal wall. This restriction had resulted in a sloping berm 14 ft. wide by about 4 feet deep remaining along each side of the canal bottom.

Very satisfactory results were obtained with the C-I-L technique, which provides a "line of weakness" at the desired boundary of the excavation. The line is a row of close-drilled holes, into which are placed specially designed hermetically sealed empty cans to make them water free. In present submarine blasting operations on the canal the Air Cushion is being placed flush along the foundation line of the retaining wall, thus avoiding any berm whatsoever. The construction company by seismic recordings have established that vibration is reduced when the air cushion is in operation.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

THE CANADIAN COUNCIL

General Secretary Appointed

Leopold Maurice Nadeau, P.ENG., of Montreal, has been appointed general secretary of the 32,000-member Canadian Council of Professional Engineers, it was announced by C. N. Murray, P.Eng., of Sydney, N.S., Council president, on March 26, 1958.

Mr. Nadeau will make his headquarters in Ottawa. In his new capacity, he will co-ordinate the activities of the engineering licensing bodies of which there are 11 — one in each province and one in the Yukon. The Council deals with all matters effecting the engineering profession at the national level.

Annual meeting of the Council will be held in Vancouver this month.

The C.C.P.E. is the national body for all provincial engineering associations. Its 12-man directorate includes one representative from each association.

Mr. Nadeau is a graduate in applied science and civil engineering from L'Ecole Polytechnique, in Montreal. His early experience includes employment as assistant plant engineer for a pulp and paper company mill and as resident engineer for the Department of Highways, Province of Quebec.

Later, he served on the technical staff of the Canadian Underwriters Association as fire protection engineer. During the war years he was engaged in designing and supervising the fire protection equipment of war industries and other installations.

L. M. Nadeau, P.ENG.

In 1946, he joined the Corporation of Professional Engineers of Quebec as assistant general secretary, and became general secretary three years later. During his term of office, the Corporation membership increased from 2,000 to more than 5,000. At the same time, he also acted as joint secretary-treasurer of the Dominion Council of Professional Engineers.

In 1955, Mr. Nadeau joined the consulting engineering firm of Racey, McCallum and Associates as assistant to the present and administrative engineer. A year later, he was appointed executive engineer in charge of the firm's Montreal division, and was elected a director of the company.

Mr. Nadeau is a councillor and honorary secretary-treasurer of the Quebec Corporation.

QUEBEC

39th Annual Meeting

Close to 1,000 Quebec engineers and their wives heard Premier Maurice Duplessis laud the engineering profession at the 39th annual meeting of the Corporation of Professional Engineers of Quebec.

The annual event, the most successful in the history of the Corporation, was held Saturday March 22 at the Sheraton-Mount-Royal Hotel, Montreal.

Well over 300 members attended the business sessions in the afternoon and more than 1,100 attended the dance during the evening.

A highlight of the meeting was an exhibition of paintings and ceramics by artist-engineers. Thirty-five tableaux were hung in the Brittany Room of the hotel and earned the admiration of hundreds of visitors.

In addition, firms and individuals displayed attractive scale models and photographs of engineering projects undertaken in 1957, or on which work had been done during the year. This exhibition was in line with the theme of the annual meeting: "Quebec, The Engineering Challenge".

At the dinner meeting, Mr. Duplessis was presented with an honorary membership in the Corporation. He was awarded the honour in recognition of his contribution to the industrial development of the province and to the establishment and improvement of engineering faculties in Quebec.

G. Piette, P.ENG.

In his address delivered to the assembled engineers Mr. Duplessis said that civil engineering was the most "indispensable" profession and that at the same time, the Province of Quebec offered engineers unsurpassed opportunities.

"No other place in North America offers as many good and great opportunities," he said. He listed a number of major provincial projects undertaken by Quebec engineers.

Mr. Duplessis added that the preservation of the rights of the engineering profession is a provincial responsibility and the engineers could be sure that the province would protect these rights.

Membership in the Corporation of Professional Engineers of Quebec soared to a record 7,000 of which almost 1,000 were new members registered last year, according to the C.P.E.Q. annual report.

The report and those of the Corporation's 22 committees formed the basis of discussion at the annual meeting scheduled for 1.30 p.m. Saturday, March 22nd in the Sheraton-Mount-Royal Hotel.

"The tremendous increase in the number of new engineers reflects the continuing industrial growth of the province," C. A. Peachey, P.Eng., outgoing president of the Corporation said.

Of the 952 new members, 650 signed up during an intensive and highly successful recruiting drive held last year.

Some 302 others registered after graduating from Quebec universities.

Mr. Peachey also expressed satisfaction with the progress of the plan for unity in the engineering profession in Canada.

Election of Officers

Guillaume Piette, P.ENG., of Quebec City, was elected president of the 7,000-member Corporation of Professional Engineers of Quebec at the annual meeting Saturday afternoon in the Sheraton-Mount-Royal hotel. He succeeds C. A. Peachey, P.ENG. of Montreal.

Mr. Piette is principal in the consulting firm of Cartier Cote, Piette, with headquarters at Lachine, Que.

He has been a member of the C.P.E.Q. since 1955; is currently a representative of the organization on the Canadian Council of Professional Engineers; a member of the Canadian Council Committee on Plan for Unity, and president of the Progressive Conservative party Association, Quebec district.

Mr. Piette, who has been engaged in consulting engineering since 1947.

He is currently consultant to Hydro-Quebec for the Lachine power project. He is a lecturer in soil mechanics at Laval University.

Mr. Piette holds B.A., B.A. Sc., and M.Sc. in civil engineering degrees, from the University of Montreal, Ecole Polytechnique, and the University of Michigan, respectively.

W. J. Riley, P.ENG., Montreal was elected vice-president and A. G. Ballachey, P.ENG., Noranda, honorary secretary-treasurer.

Council members are elected to two year terms, Mr. Peachey remains on Council as immediate past president.

Other new councillors are Professional Engineers Gerald N. Martin, and J. Georges Chênevert, both of Montreal and Arthur Piché of Quebec. Oscar Gislason, P.ENG., Arvida, was re-elected by acclamation.

Outgoing members of Council are Engineers Léopold Nadeau, past honorary secretary-treasurer; Léo Roy, who was past president last year, and Yvon De Guise, Montreal, and Robert Painchaud, Quebec, councillors.

NEW BRUNSWICK

Annual Meeting

The annual meeting of the New Brunswick Association of Professional engineers was held on February 1, 1958 at Saint John.

Elected president for the 1958 term of office was D. O. Turnbull, of the firm of Turnbull and Scott Limited, consulting engineers of Saint John. Mr. Turnbull also served as president in 1952. He succeeds W. D. G. Stratton, district airways engineer, of Moncton. Other officers elected were: vice-president, S. B. Cassidy, of Fredericton; councillors, F. L. Doty, Saint John, R. S. Miles, Fredericton; and W. E. Peterson, Dalhousie; R. D. C. Clark of Saint John is the secretary-registrar.

Mr. Turnbull urged members to support the unification between their own group and The Canadian Council of Professional Engineers.

Dr. Colin B. Mackay, guest speaker and president of the University of New Brunswick stressed the increasing importance of a liberal education for today's engineers, with courses in the humanities and social sciences, supplementing their specialized technical training.

In answer to a fear prevalent among some educators that extra training would mean a congested curriculum and superficial treatment of the humanities, Dr. MacKay cited a report of the American Society for Engineering education noting the success of such a venture in more than thirty leading engineering schools in the United States.

D. O. Turnbull, P.ENG.

ONTARIO

Accrediting Committee Formed

(From the Journal of the Association of Professional Engineers of the Province of Ontario)

At the January meeting of Council it was considered that with the increasing number of engineering courses being offered in Ontario an accrediting committee should be set up. The following were appointed: Dr. G. Ross Lord, P.Eng., chairman; H. G. Conn, P.Eng., dean of the faculty of applied science, Queen's; Professor V. G. Smith, P.Eng., Toronto; Professor H. S. Pollock, P.Eng., Queen's; and Professor B. Etkin, P.Eng., Toronto. Briefly, the terms of reference are: to recommend to Council a guiding policy for accreditation and to appoint accrediting teams when applications are received for approval of new courses.

Engineering courses are being offered at nine Institutions; Queen's, Toronto, Essex, Sudbury, Lakehead, Ottawa, Carleton, Ontario Agricultural College, and Waterloo.

The committee has held its first meeting and will present for consideration to the April meeting of Council a policy for accreditation.

Engineers and the Political Arena

(Taken from the Section "President Carson Says," in the Professional Engineer)

"By the time you read this, it is probable that the results of the federal election will be history. It would be interesting to know how many of our members take an active part in provincial and federal politics but the information is not readily available. As to those who enter the field as candidates, the number appears to be negligible.

In a recent address in Pontiac Mich., former U.S. Secretary of Defense Charles E. Wilson, stated that he thought business men still have a place in government—"except on the level of politics". If we may take any comfort from it, he was referring to U.S. politics.

Speaking of engineers, Mr. Wilson, an engineer himself and president of General Motors Corporation, before joining the Eisenhower cabinet, continued: "I don't think engineers are trained for politics. They have too much respect for truth and fact to be successful politicians."

Before resigning from the cabinet this gentleman was the author of quite a number of controversial statements, often finding himself in hot water as a result. But we will not quarrel with him on the question of being truthful and factual. What is discouraging is the thought that we are unfit, because of that, to venture into the political arena. Perhaps what this country needs is more of those attributes in high places, more statemanship and less political high-jinks, more "truth and fact," and less irresponsible attacks on those who are trying to do a good job, in short, more engineers.

A report of recent studies of the potentials of the engineer states that "the engineer's mental makeup is likely to be directed toward a specialized area. Personality tests show that he normally has concentrated on his specialty at the expense of his development as a social animal. Often he is short of human relations "know-how". Many of our members have already proven this to be an unfair indictment but if it is a commonly held opinion, it is time we changed it.

I suggest, therefore, that those who have not already done so start busying themselves in public affairs. If you will do so, the community, your Association, and you, as an individual, will definitely benefit from your activity. And, notwithstanding Mr. Wilson's pronouncement, you too may someday be prime minister. Apart from its spiritual significance, the ultimate purpose of life is service to humanity."

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Colonel H. G. Thompson, M.E.I.C. The Engineering Institute is sorry to report the death of the retired executive assistant general secretary of the organization at Pickering, Ont., April 19, 1958. An obituary will appear in the June issue of the *Journal.*

Ernest R. Clarke, M.E.I.C., of Scarborough, Ont., retired consulting engineer, died on July 5, 1957.

Ernest Randolph Clarke was born at Montreal on October 11, 1875. He attended McGill University and graduated with a B.A.Sc. in mechanical engineering in 1896. His first position was that of draughtsman for the Royal Electric Company, Montreal. Within the next few years he also served as an engineer with the 'S.S. Vancouver' of the Dominion Line, and with the Superior Power Company, the Northey Company Limited, Toronto, as a mechanical engineer, and the Canada Foundry Company as a hydraulic engineer. He was named a partner in the firm of Connor, Clarke and Simonds, consulting engineers, at Toronto in 1902.

For a number of years, Mr. Clarke was engaged in general contracting in Toronto. Later he operated a consulting engineering practice in that city.

Mr. Clarke joined the Institute as an Associate Member in 1906, transferred to Member in 1940, and attained Life Membership in 1946.

H. W. Vaughan, M.E.I.C., retired superintendent, electrical division, City of Montreal, died after a long illness in that city on February 18, 1958.

Harold Wilfred Vaughan was born at Wolfville, N. S., on May 3, 1896. He studied electrical engineering at McGill University and in 1921 graduated with a B.Sc. degree in electrical engineering. Almost immediately he began what was to be a lifetime career with the City of Montreal, electrical commission as an assistant to the chief engineer. In 1923 he transferred to the post of assistant superintendent of the light department, at the city hall. He assumed the post of superintendent of the lighting department in 1938. The appointment of superintendent of the electrical division was announced in 1944.

Mr. Vaughan retired from active professional duties in 1955.

He joined the Institute as a Student Member in 1920, tranferred to Associate Member in 1926, and became a Member in 1940.

Stephen John Murphy, M.E.I.C., former head of the instruments and control systems laboratory of the division of mechanical engineering, National Research Council of Canada, died on February 2, 1958.

Mr. Murphy was born at Montreal, Que., on December 30, 1893. He graduated from McGill University in civil engineering in 1913.

He began his engineering career in 1913 as a steel designer with the Dominion Bridge Company, Montreal. The following year he joined the Structural Engineering Company of Montreal in a similar capacity.

In 1915 Mr. Murphy entered the topographical survey branch, department of the Interior, as survey physicist. In 1920 he joined the physical testing laboratory of the same department. From 1924-1931 he was also assistant supervisor of the laboratory.

In 1931 Mr. Murphy joined the division of physics and engineering of the National Research Council as leader of the aeronautical instruments group. In this capacity and until World War II, Mr. Murphy was responsible, among other things, for the maintenance and calibration of all aircraft flight instruments used by the R.C.A.F. During World War II, as head of the aircraft and allied instruments laboratory of the division of mechanical engineering, National Research Council, he collaborated with the armed services on a number of special projects and investigations. Subsequently, Mr. Murphy pioneered the design and development of a unique series of airborne mechanical optical recorders for aeronautical research application.

Mr. Murphy joined the Institute as an Associate Member in 1922, was transferred to Member in 1940 and on January 1, 1957 attained Life membership.

C. P. F. Faulkner, M.E.I.C., retired district engineer for the B.C.-Yukon district of the Department of Public Works at New Westminster, B.C., died at North Surrey, B.C., on October 4, 1957.

H. W. Vaughan, M.E.I.C.

Charles Frederick Faulkner was born at St. Alban's, Herts., England, on June 29, 1888. He had his engineering training at the Heriot-Watt College, Edinburgh, and his apprenticeship with James Milne and Son, Edinburgh. He moved to Vancouver in 1910, and the following year was articled to Alister Robertson, B.C.L.S., in Victoria. While there he became one of the original officers of the 88th Regiment of the Victoria Fusiliers.

After service during the First World War in Canada, England, and France, he joined the staff of the Canadian National Railway. He then became employed on road location and construction with the provincial government and later assistant engineer with Peter Lyall and Son on the construction of the Esquimalt Dry Dock. He joined the Nelson office of the Department of Public Works in 1925, and upon consolidation of the B.C. districts, he was transferred to New Westminster. From 1934 to 1949 he was in charge of all works on the Northern coast. A year later he was appointed district engineer. In 1952 he was named district engineer of the British Columbia and Yukon territory

Retiring in 1955, he continued for a year to give service to his profession as a consultant in connection with the Okanagan Flood Control project.

Mr. Faulkner joined the Institute as an Associate Member in 1921, transferred to Member in 1940.

Walter O. Sorby, M.E.I.C., Atlantic district manager, Canadian Westinghouse Company, Halifax, N.S., died at Guelph, Ont., on February 3, 1958.

Born on August 18, 1901 at Guelph, Mr. Sorby attended public and collegiate schools in that city. He enrolled at the University of Toronto for his engineering studies and was in 1925 awarded a B.A.Sc. degree in electrical engineering.

Mr. Sorby joined his present company in 1928 after serving with the Westinghouse Electric Corporation on its student training course and at Elmira, Pa.

W. O. Sorby, M.E.I.C.

His service with the Canadian Westinghouse Company included several years at Winnipeg and Montreal, prior to his appointment of Atlantic district manager at Halifax. His work put him in contact with people in all phases of the electrical industry, mining, pulp and paper, and the retail trade.

He served with the Canadian Artillery from 1940 to 1946 and retired with the rank of major after extensive overseas service. His final army appointment was that of technical staff officer, with the rank of major, at Canadian military headquarters, London, Eng., in charge of technical work on artillery equipment. This appointment included liaison with the British ministry of supply and the war office.

Mr. Sorby joined the Institute as a Member in 1945.

A. E. MacDonald, M.E.I.C., sales engineer with the Holden Manufacturing Company Limited, Montreal, died at Quebec City, Que., on February 12, 1958.

Arthur Lamond MacDonald was born at Glace Bay, N.S., on June 23, 1914. Educated at Acadia University and at the Nova Scotia Technical College he was awarded a B.Sc. in 1935, at the latter college and in 1938 qualified for a B. Eng. degree, electrical, at N.S.T.C. On his final graduation he became a junior engineer with the Eastern Light and Power Company, Sydney, N.S. The appointment was however, short-lived. On August 29, 1939 Mr. MacDonald enlisted in the Royal Canadian Engineers. Works officer in charge of works and construction of buildings and fortifications at that time, he was given charge of searchlight installation, with the rank of captain, on the Canadian East coast and Newfoundland. In 1942 he assumed the duties of second in command of a heavy coast battery, Royal Canadian Artillery. He continued to serve in this capacity until 1944. His final army post, was that of inspector of electrical engineering stores, for the Inspection Board of the United Kingdom and Canada. He held the rank of major.

At the close of the war he joined the firm of the Holden Manufacturing Company Limited at Montreal, and was associated with this company at the time of his death.

Mr. MacDonald joined the Institute as a Student Member in 1938, transferred to Member in 1945.

Alfred Edwin McGruer, M.E.I.C., engineer with the Canadian Pacific Railway, electrical equipment system, at Montreal, died in that city on March 1, 1958.

Born at Barrow, England, on December 13, 1900, Mr. McGruer came to Canada at an early age. He studied electrical and mechanical engineering at the Montreal Technical Institute, the University of Toronto and the Central Technical School, Toronto. He also attended special courses in the United States, with the diesel locomotive schools of the General Electric Company and the General Motors Corporation at Schenectady, N.Y. and Chicago. Early in his career Mr. McGruer was associated with Canadian Vickers Limited, at Montreal, the Montreal and Southern Counties Railway, the Hydro-Electric Power Commission of Ontario and Canadian Pacific Railway. He became permanently employed with the C.P.R. in 1928 as chief electrician, at the West Toronto shops. In 1942 promoted to supervisor of stationary power plants, Eastern region, at Toronto, he assumed the post of electrical engineer for that region in 1946. He was named to the post of general electrical engineer, systems, at Montreal, in 1953, which appointment he held at the time of his death.

Mr. McGruer joined the Institute as a Member in 1954.

Elections and Transfers

On the recommendation of the Admissions Committee the following elections and transfers were effected at the meeting of Council on April 19, 1958.

Members: P. E. Ayre, Montreal; R. P. Bourgeois, Montreal; M. M. Chmilar, Calgary; H. K. Fairbanks, New York; J. M. Ferguson, Cornwall; S. Forrester, Montreal; K. R. Fowler, Calgary; K. P. Furness, Toronto; H. F. Gautrin, Montreal; J. Greenaway, Winnipeg; D. W. Gunter, Winnipeg; L. H. B. Hatherell, Montreal; Z. Heczko, Montreal; D. J. Inglis, Montreal; G. H. Jackson, London; F. L. Johnson, Toronto; E. J. Kavanagh, Montreal; T. K. Kearney, Montreal; R. O. King, Ottawa; F. H. Knelman, Montreal; S. L. Mason, Devon, Alta.; F. G. Milligan, Toronto; A. M. Monneret de Villard, Montreal; R. Neal, Montreal; J. C. Ormond, Isle Maligne; J. J. O'Sullivan, Brampton; P. J. Parsons, London, Eng.; R. W. Pryer, Sept Iles; G. E. Reid, Temiskaming; T. J. Robertson, Edmonton; E. R. Rowbotham, Montreal; R. W. Ruthman, Montreal; E. W. Smythe, Toronto; C. L. Speiden, Shawinigan; M. J. Taylor, Montreal; P. S. Thornton, Montreal; O. van Deurs, Atikoken; G. E. Weir, Montreal; H. B. Young, Winnipeg.

Juniors: W. R. Allan, Montreal; M. V. Allinson, Calgary; J. P. A. Arsenault, Montreal; I. G. Bowie, Port Arthur; D. J. Bull, Sept Iles; G. P. Button, Three Rivers; M. H. MacLeod, Orillia; C. F. Marston, Brownsburg; C. J. Mills, Shawinigan; F. Moller, Montreal; J. Perreault, Montreal; P. M. Power, Sydney; D. G. Wood, Sudbury.

Junior to Member: D. G. Best, Montreal; G. D. Campbell, Ottawa; R. H. Darke, Windsor; B. G. Fraser, Toronto; J. Greenberg, Ottawa; A. A. Greenlees, Sarnia; J. G. Hooper, Peterborough; W. G. Ivany, Brownsburg; V. D. MacDonald, Cornwall; A. F. Morrison, Montreal; S. Oancia, Montreal; K. J. Radcliffe, Sarnia; G. H. Shaw, Sarnia; R. H. Whittaker, Toronto.

Student to Junior: M. O. Diorio, Joliette; L. R. Keddy, Windsor; R. G. Plamondon, Montreal.

STUDENTS ADMITTED

University of Toronto: D. M. Aiton; S. M. B. Bailey; M. K. Bonnycastle; D. H. M. Branion; A. A. Bruneau; D. Buchanan; A. Z. Capri; R. K. Cornbill; K. A. Craig; A. Cronin; L. A. Cummings (Miss); T. L. Easterbrook; J. H. Flett; Amy M. Forman; G. R. Frazer; R. K. Gibson; W. J. Harmer; L. S. Harrison; W. C. A. Hay; A. R. Hill; J. Hunt; R. I. Jones; D. A. Keenleyside; D. C. Mabee; R. McDermott; K. A. McLennan; W. P. Reynolds; M. R. O'Shaughnessy; J. M. Perz; R. J. Sanders; D. J. Shepley; K. N. Smith; T. S. Szekely; J. Van der Heyden; J. W. Van Loon; F. J. Wawrychuk; R. A. Williams; A. E. Wilson; J. F. Zupancic.

University of British Columbia: F. J. Brooks; M. S. Chappell; R. G. Fraser; B. A. Heskin; I. R. McAllister; H. Norrish; D. E. Park; P. J. Reader; A. Reinemo; D. J. Thomson; R. J. Van Ryswyk; R. K. Wiltse.

University of Alberta: R. R. Alton; I. J. Curry; M. Dzidrums; R. C. Howe; G. L. Kulak; A. E. McMullen; R. W. Pollock; S. Skrypiczaiko.

Nova Scotia Technical College: F. J. Bradbrook; W. A. Castell; C. N. Colwell; J. L. Cullinan; B. C. Smith; E. J. Stewart; L. V. Windsor.

McGill University: E. Bizon; S. I. K. Bojnowski; P. S. G. Campbell; J. D. Chase; T. Fancott; R. C. Nesbitt; R. P. Racicot.

St. Francis Xavier University: J. H. Bethune; L. A. Chiasson, P. J. Chiasson; C. R. S. Haslam; A. M. Laliberte; J. Rankin; G. G. Weeks.

Queen's University: E. C. Hanna; D. G. Hilliard; E. J. Jackiw; J. E. Vollmer.

Royal Military College: J. B. Franklin; P. V. Glasheen; P. P. M. Meincke; R. L. Walkington.

St. Dunstan's University: E. J. Nagy; F. Tam. **Sherbrooke University:** J. C. Gaudette. **Ontario Agricultural** College: A. B. Campbell. **Univ. of Manitoba:** E. H. Geres.

Mount Allison University: M. A. Pratt.

Rensselaer Polytechnic Institute: A. J. Muradliyan.

Graduate: R. G. Bethell, University of Saskatchewan, 1957, B.Sc. (civil).

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members: L. Boyer; D. W. McCallister; H. L. Johnston, A. C. Pitt.

Juniors: H. Karasiuk; W. B. Peacock; G. D. Morrison; N. E. Pullin.

Junior to Member: T. E. Wilson.

SASKATCHEWAN

Members: E. E. Brooks; R. K. Craig; R. W. Durie; A. Guthrie; W. H. W. Husband; W. H. Jones; J. B. Lintz; N. Ludwick; R. L. Padget; J. L. M. Scott; D. M. Shier; K. M. Stephenson; J. L. Stoik; H. J. Strain; S. Trausch; D. T. Waleski; M. P. Werner.

Juniors: P. W. McAra; A. I. Reed; L. H. Sawatsky.

Students: G. H. Anderson; J. G. Anderson; W. G. Atkinson; V. G. Beckie; R. J. Bell; G. H. Beuker; R. E. Beveridge; W. G. Bierlmeier; R. H. Billings; R. L. Blanchette; B. G. Brown; P. E. Brown; R. H. Bryce; D. L. Burke; D. C. Burr; R. G. Cameron; A. J. Cartier; D. F. Child; E. P. Chou; L. W. G. Collins; G. T. Conn; H. R. Daniel; A. Dzuba; W. D. Evans; H. P. Fahlman; M. Feldman; D. J. Ferguson; R. George; K. N. Gulstene; T. E. Hage; H. Heinmark; H. M. Hesjedal; F. A. Hlohovsky; G. F. Hutch; W. S. J. Jakubcak; P. Jmaeff; K. D. Johnson; A. L. Kipling; E. E. Kuntz; W. C. Lee; D. R. O. Lennox; R. Loch; J. E. Lovecky; M. L. Lowe; D. L. MacLeod; A. I. Massier; R. G. McCarthy; J. E. McGuire; F. B. McPherson; M. F. Main; D. G. Mathieu; V. E. Mayerle; J. R. Mayor; D. G. Mitchell; T. J. Monastyrski; D. C. Morton; G. B. K. Neely; W. A. Neff; R. W. Nordquist; L. E. Novakowski; D. G. Olafson; G. Paicu; G. A. Palichuk; B. W. Petschulat; B. G. Pryce; H. R. Ramstead; W. E. Randall; H. G. Reesor; J. W. Rittinger; C. A. Rose; A. A. Schuldt; D. E. Shemansky; D. A. Smith; W. L. Smith; N. Soloducha; L. E. Stanley; P. D. Stata; P. P. Steinhubl; D. M. Stewart; J. D. Stothers; F. L. Stromotich; D. A. Vaughan; V. G. Walls; L. S. Werboweski; G. J. Will; M. J. Yablonski; E. A. Yasinko; D. R. Yont; D. A. Young; J. E. Zuk.

Junior to Member: K. W. Domier; J. S. Dudar; J. W. Hawthorne; D. G. Matheson; K. A. Mellish; T. L. Salmon; G. L. Sladek; A. Stewart; P. van Vliet; G. J. Willmon.

Student to Junior: R. J. Clarke; G. Cox; M. J. Demetrick; S. A. Dencsak; B. H. Hamilton; M. M. Hawrysh; J. Martin; R. N. Thompson; S. S. Turek.

NOVA SCOTIA

Member: H. L. Cameron.

MANITOBA

Member: P. G. Hadrill; W. G. Salway.

Personals

News of the Personal Activities of Members of the Institute

H. G. Welsford, M.B.E., M.E.I.C., president and managing director of the Dominion Engineering Works Limited, has been elected president of Dominion Bridge Company, Montreal.

Mr. Welsford started his career with Dominion Bridge at the age of sixteen.

Transferred to Dominion Engineering in 1922, he was appointed general manager of the company four years later. He was named vice-president of the firm in 1938 and assumed responsibility as president of the organization in 1951. In that year he also became vice-president of the Dominion Bridge Company.

A. G. Lester, M.E.I.C., has been named vice-president of The Bell Telephone Company of Canada effective April 1st. With the company 36 years, his service was interrupted several times From 1942-45 he was with the Royal Canadian Corps of Signals, retiring as a major. He was on loan to the Federal Government as an industrial representative at National Defence College, Kingston, in 1949-50; and two years later was called to the Department of Defence Production, Ottawa, as associate director, electronics division.

Mr. Lester's most recent appointment has been that of assistant vice-president (engineering) and general manager of the special contract department.

He was awarded the Ross Medal of the E.I.C. in 1955.

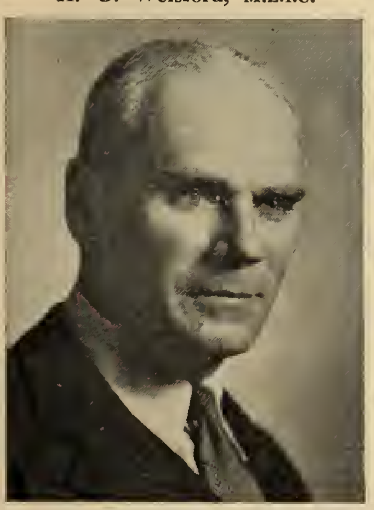
H. M. Finlayson, M.E.I.C., (B.Sc., civil, McGill, 1923), formerly manager of the hydraulic resources department of the Shawinigan Water and Power Company, Montreal, has been appointed an assistant vice-president of the Company. He will continue to be responsible for the management of the company's hydraulic resources department.

Mr. Finlayson, who joined The Shawinigan Engineering Company in 1928, was named manager of the hydraulic resources department in 1954.

H. M. Finlayson, M.E.I.C.

A. G. Lester, M.E.I.C.

H. G. Welsford, M.E.I.C.



Leo Scharry, M.E.I.C., (B.A. Sc., civil, Ecole Polytechnique, 1946), of the Leduc Electrical Company, Montreal, has been elected vice-president of the firm. Late in 1957 Mr. Scharry was appointed vice-president of the organization following a number of years experience with the Sangamo Company Limited, and the Wagner Electric Company, Montreal, as technical sales representative.

Leo Scharry, M.E.I.C.

N. F. Moodie, M.E.I.C., (B.A.Sc., mining, U.B.C., 1936), has, since November 1957, been engaged in operations as an independent consultant at Calgary. He was previously associated with Dutton-Williams Brothers Limited, Calgary, and before that with the National Defence Headquarters, R.C.N., Ottawa, for several years.

Henri A. Audet, M.E.I.C., (B.A., Ecole Polytechnique, 1938; B.Sc.A., Ecole Polytechnique, 1943), formerly Quebec regional engineer for the Canadian Broadcasting Corporation, Montreal, is president and general manager of Television St. Maurice Inc. This is a new company organized by Mr. Audet to operate station CKTM-TV in the Three-Rivers, Que., area.

W. J. Riley, M.E.I.C., of Montreal has been appointed the representative of the Corporation of Professional Engineers of Quebec on the Council of the Engineering Institute. Mr. Riley is chief engineer with Sperry Gyroscope Company of Canada Ltd.

Professor M. L. Baker, M.E.I.C., of Halifax, N.S., has been appointed representative of the Association of Professional

Engineers of Nova Scotia to the general council of the Engineering Institute of Canada. Prof. Baker, who has been active in both professional organizations for a number of years, is a member of the faculty of mechanical engineering at the Nova Scotia Technical College.

H. J. Leitch, M.E.I.C., (B.Sc., civil, McGill, 1926), has been appointed engineer-in-charge of structural steel sales for the Dominion Bridge Company Limited, which he joined in 1929.

Mr. Leitch inaugurated operations of the Sault Structural Steel Company Limited, now operating under the name of Dominion Bridge Company Limited, at Sault Ste. Marie in 1937 and for some years afterwards was its manager. During World War II, Mr. Leitch was away from Dominion Bridge for a period, first as general sales manager of Algoma Steel Corporation and then as assistant director general, naval shipbuilding branch, Department of Munitions and Supply.

J. T. Fisher, M.E.I.C., (B.A.Sc., McMaster, 1927), until recently plant personnel supervisor of the Toronto area of the Bell Telephone Company of Canada, has been named chief engineer of the area. Mr. Fisher has been with the Bell since his graduation. He was special studies engineer in the plant extension division in 1950. In 1952 he was appointed district plant superintendent, Toll area, becoming plant supervisor during the following year. He maintained this position until 1955 when he was named to his most recent appointment.

A. J. Groleau, M.E.I.C., (B.Sc., elec., McGill, 1928), until recently chief engineer of the toll area of the Bell Telephone Company of Canada with headquarters in Montreal, becomes plant manager of the area. Mr. Groleau, who joined the Bell in 1928, has held various engineering posts with the company, being successively traffic assistant, dial equipment engineer, general traffic engineer and general facilities superintendent.

W. R. Staples, M.E.I.C.

He was named chief engineer, Eastern area, in 1951, and became toll area chief engineer in March 1953.

John Austin Loy, M.E.I.C. (B.Sc. civil, McGill, 1921), plant manager of the toll area of the Bell Telephone Company of Canada, has retired from active professional life after thirty-five years service with the company. He was plant manager of the toll area in Montreal and Ottawa, a position he has held since 1953.

Mr. Loy began his career as an inspector with the Department of Public Highways of Ontario in 1922. Within a short time he became associated with the construction staff of the Bell Telephone Company, eastern division.

W. R. Staples, M.E.I.C., (B.Sc., mech., Sask., 1944), professor of mechanical engineering, at the University of Saskatchewan has been promoted to assistant dean of the college of engineering.

He joined the staff of the University of Sask. in 1946 and became assistant professor, college of engineering and then associate professor in 1947.

He was in 1955 elected president of the Association of Professional Engineers of Saskatchewan, at the same time serving as chairman of the Sask. Branch of the E.I.C.

H. J. Leitch, M.E.I.C.

G. V. Meagher, M.E.I.C., (B. Eng., mech., McGill, 1942), has joined the consulting engineering firm of Dilworth Secord and Associates Ltd., Toronto, as a third principal.

Mr. Meagher has worked with National Research Council, Ottawa, as a mechanical designer and consultant at Vancouver, with Canadian General Electric Limited, Montreal, as manager of marketing research, major appliance department, and as director, market research, for Moffats Limited and affiliated companies.

P. M. Sauder, M.E.I.C., of Edmonton, retired general manager of the western irrigation district, with the Department of Water Resources, Province of Ontario, has been re-appointed as a representative of the Association of Professional Engineers of Alberta on the Council of the Engineering Institute.

Mr. Sauder has represented the Association in this capacity since 1944.

A. Madeyski, M.E.I.C., is now employed by N. Slater Company Limited, Hamilton, Ont. as a mechanical engineer and

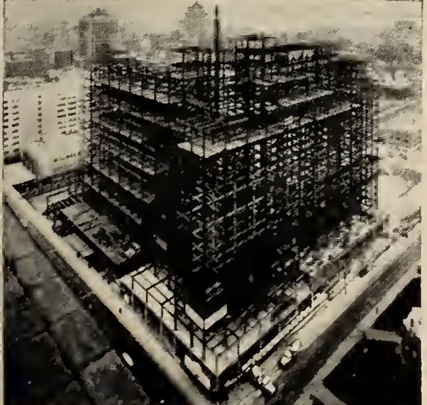
J. T. Fisher, M.E.I.C.

A. J. Groleau, M.E.I.C.

J. A. Loy, M.E.I.C.

Photo courtesy Canadian National Railways.

He had to be quiet...



This man is one of a team of despatchers in the C. N. R. Central Station, Montreal. The safety of thousands of passengers depends on him, and others like him, as trains are routed through the maze of C. N. R. tracks. Such responsibility calls for experience, concentration and above all *quiet.*

When the new Queen Elizabeth Hotel was being built directly above his head a special problem arose. How to erect this large steel structure without distracting noise so that railway operations could be safely continued. Dominion Bridge engineers, working closely with C. N. R. officials, met the challenge. Riveting was virtually eliminated and special field erection procedures were evolved, using welding and bolting.

Once again steel proved its versatility in the solution of a pressing construction problem.

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• PERSONALS

metallurgist for the company. Formerly he was with the Ontario Hydro-Electric Commission as a research engineer.

C. W. Currie, M.E.I.C., (B.Sc. elec. N.S.T.C., 1928), of Charlottetown, P.E.I., district engineer with the Department of

C. W. Currie, M.E.I.C.

Public Works is the 1958-1959 choice of the Charlottetown Branch for chairman.

Mr. Currie, who has been associated with the Department of Public Works for more than twenty years has held the post of district engineer since 1954.

Frederick Palmer, M.E.I.C., (B.Sc., civil, Nova Scotia Technical College, 1913), retired from professional life and the post of Consul General of Canada, at Chicago, Ill., in June 1957. Mr. Palmer served as Canadian Government Trade Commissioner in a number of countries. In 1950 he was assigned to open a Canadian Consulate at Manila.

He has chosen Toorak, Victoria, Australia as his home.

T. F. Kennedy, M.E.I.C., (B.Sc., civil New Brunswick, 1941), has been elected chairman of the Port Hope Branch of the

T. F. Kennedy, M.E.I.C.

This station-type Switchgear Unit used in Ontario Hydro's St. Lawrence Powerhouse has two airblast circuit breakers, rated 3500 amperes, 15000 volts, 2280 MVA asymmetrical interrupting capacity and pneumatic disconnects.

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KIRKLAND LAKE: Mine Equipment Ltd.
WINNIPEG: Power & Mine Supply Co. Limited
VANCOUVER: Gordon Russell Ltd.

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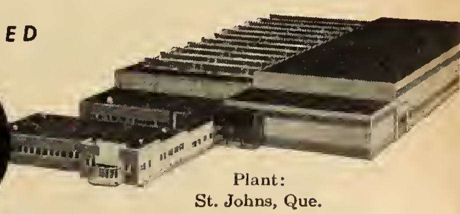


Plant:
St. Johns, Que.

FP-8-5

• PERSONALS

Institute for the 1958-59 term of office.

Mr. Kennedy was or a number of years associated with the Department of Reconstruction, research and development branch Enamel and Heating Products Limited, Amherst, N.S., as a plant superintendent, before moving to Ontario.

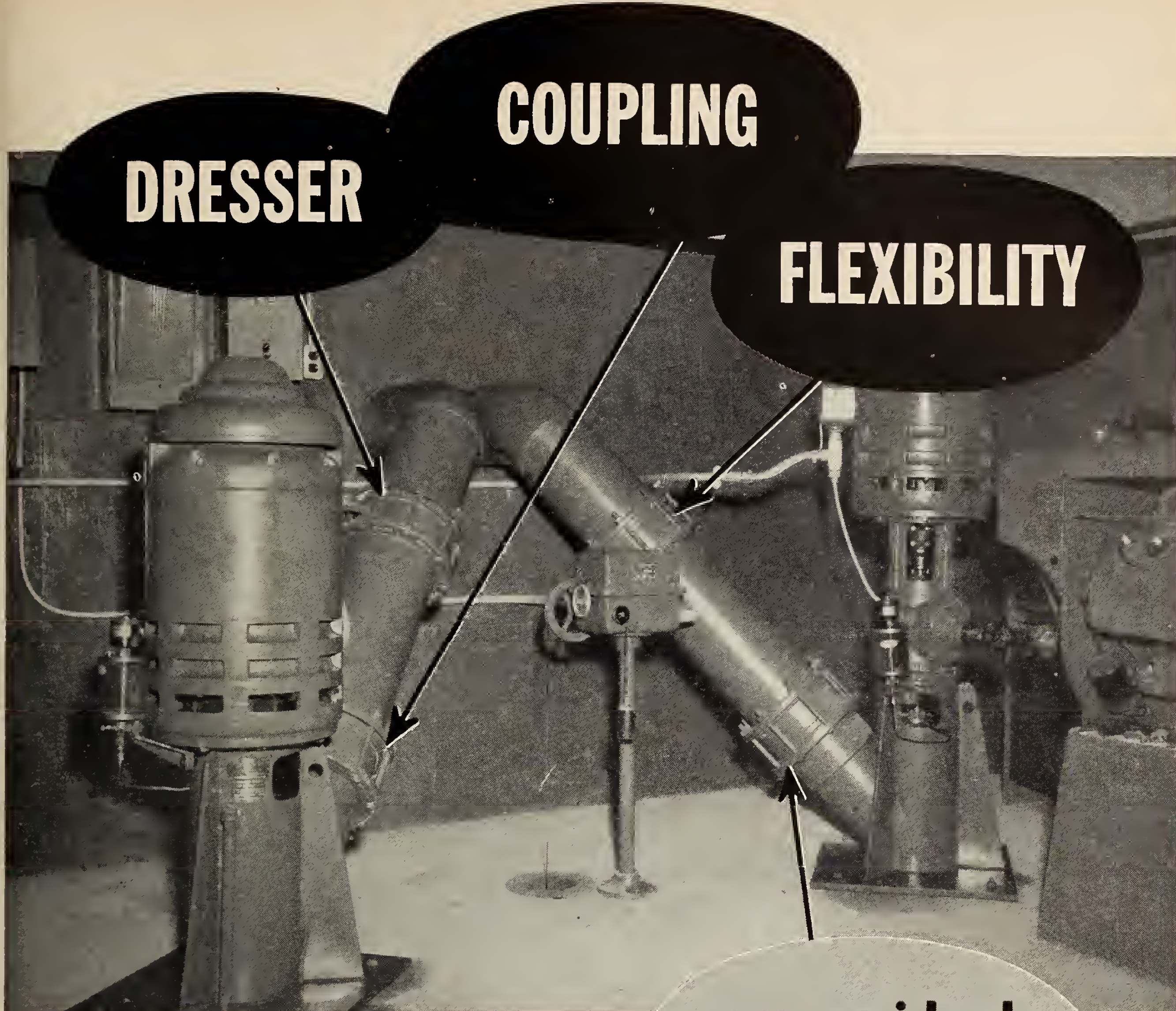
H. C. Bates, M.E.I.C., (B.Sc., civil, Queen's, 1917), has been elected chairman of the Huronia Branch of the Institute. Mr. Bates, who is associated with the Trans-Canada Highway division of the Department of Resources and Development, was in 1956 elected to represent the Huronia Branch of the Council of the Institute.

H. C. Bates, M.E.I.C.

Mr. Bates joined the engineering staff of the Trans-Canada Highway in 1953 after 20 years of road building experience.

Hector Chaput, M.E.I.C., (B.Sc., elec., Queen's, 1941), manager of equipment and power with the Ottawa Transportation Commission is the choice of the

H. Chaput, M.E.I.C.



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• PERSONALS

Ottawa Branch of the Institute as chairman for 1958. Mr. Chaput, who has been associated with the Ottawa Transportation Commission since 1949 has also had professional experience with the Canadian General Electric Company and the English Electric Company.

Edwin Ralph Gayfer, M.E.I.C., (B.Sc., civil, Manitoba, 1933), of Penticton, B.C., has been elected chairman of the Central British Columbia Branch of the Institute. Mr. Gayfer is superintendent of works with the City of Penticton.

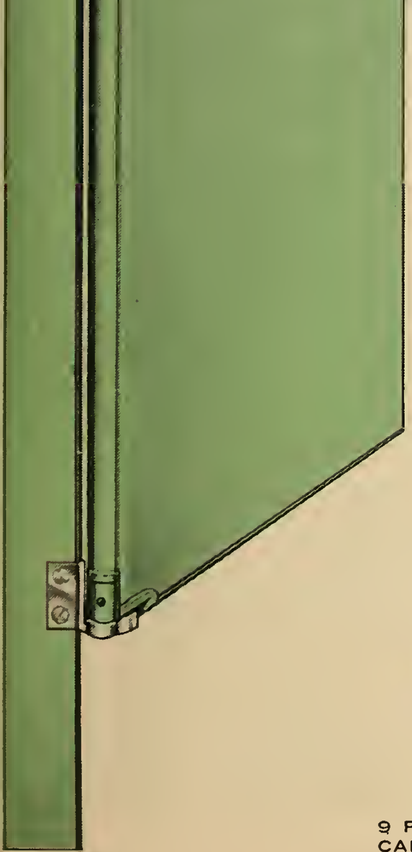
E. R. Gayfer, M.E.I.C.

Frank Hughes, M.E.I.C., (B.Sc., elec., Manitoba, 1946), has moved to Western Canada to accept an appointment with the Federal Department of Public Works at Banff, Alta. Mr. Hughes' career to date has included service with Canadian Industries Limited, Montreal, the International Nickel Company of Canada, at Copper Cliff, Ont. He was also engaged in civil engineering for the R.C.A.F. in Ottawa.

P. C. Kempe, M.E.I.C., (dipl. mech. Balaret School of Mines, 1950), of Canada Iron Foundries Limited, has been transferred from Toronto to Hamilton, where he holds the post of sales manager, special products division of the organization. He has been associated with the company in various capacities since his graduation.

Philippe A. Benn, M.E.I.C., is now senior partner of Philippe A. Benn and Associates, consulting engineers of Montreal and executive vice-president of Integrated Consultants Ltd., Montreal, and not as otherwise stated in other sections of previous issues.

J. K. Swain, M.E.I.C., has accepted the post of Ottawa district manager of Bepco Canada Limited. Mr. Swain who started as a technical trainee at Bepco's "Lancashire-Crypto" works, attended technical college in the United Kingdom and



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We offer a full range of Toilet Compartments with this new 7700 Hinge*. All are designed to use space economically and to facilitate cleaning and are engineered to give many years of service with minimum upkeep. A wide choice of baked-enamel finishes. For detailed information ask for Toilet Compartment Catalogue No. 56.

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• PERSONALS

served as a captain in the R.E.M.E. during the last world waor in the United Kingdom, India and Burma.

Mr. Swain was previously with Bepco's Montreal district sales force.

Ian D. Patterson, M.E.I.C., (B.Sc., mech., Queen's 1943), has recently accepted the position of manager of Thackeray Industrial Maintenance Limited, in Waterloo, Ont. Secretary-treasurer of the London Branch E.I.C. in 1951, Mr. Patterson was previously a partner with the M. M. Dillon Company in London, Ont.

J. B. Edwards, M.E.I.C., (B.Sc., mech., Saskatchewan, 1941), formerly assistant superintendent of engineering at the Three Rivers Mill of St. Lawrence Corporation has been promoted to the position of superintendent of engineering at East Angus, Que.

W. N. Simmons, M.E.I.C., (B.Sc. mech., Queen's, 1936), has been elected chairman of the Brockville Branch of the Institute.

Mr. Simmons is employed with Canadian Industries Limited, textile fibres division, at Maitland, Ont.

J. E. Freeman, M.E.I.C., (B.Eng., mech., McGill, 1943), formerly superintendent of engineering at the East Angus mill of the St. Lawrence Corporation Limited, has been appointed project engineer in the new construction program at Red Rock, Ont. Prior to joining the St. Lawrence Corporation, Mr. Freeman was junior engineer with the New Brunswick International Paper Company Limited, Dalhousie, N.B., and resident engineer, Abitibi Power and Paper Company Limited, Sturgeon Falls, Ont.

T. H. Shillingford, M.E.I.C., (B.Eng., civil, N.S.T.C., 1950), is employed as a director of works in road construction projects for the Dominican Government at Roseau, B.W.I. Mr. Shillingford left the Montreal Engineering and Company in 1954 in order to join the Public

W. N. Simmons, M.E.I.C.

• PERSONALS

Works Department, Dominican Republic as a road construction engineer. Promoted to senior engineer in 1956, he became acting director of works in 1957.

L. F. Giauque, M.E.I.C., (B.Sc., mech., Sask., 1942), is project engineer for the Spruce Falls Power & Paper Company Ltd., Kapuskasing, Ont. Mr. Giauque joined the company in 1945 as mechanical engineer. Further to his actual position, he also carries on the business "Giauque Enterprises".

Don A. McRae, JR.E.I.C., (B.Sc., elec., Manitoba, 1948), holds the position of chief electrical engineer in the manufacturing department of Ets-Hokin and Galvan Inc., in Wilmington, Calif. Earlier, Mr. McRae was in charge of all electrical construction of Cemco Inc., Downey, Calif.

J. P. Dagenais, JR.E.I.C., (B.A.Sc., C.E., mech. and elec., Ecole Polytechnique, 1948), sales engineer with Dominion Bridge Company Limited since 1954, has been appointed combustion sales engineer, Eastern division.

Mr. Dagenais is a former president of the junior section of the Montreal Branch of the E.I.C. He is presently serving as secretary of the Institute's program committee.

J. P. Dagenais, JR.E.I.C.

J. J. Harris, JR.E.I.C., (B.Sc., mech., Univ. of Man., 1951), has been appointed mechanical engineer (car) of the Canadian National Railways at Montreal.

Mr. Harris who has been associated with the C.N.R. since graduation, has been assistant engineer (car), mechanical engineer in the shop methods department and with the research and development department economics branch.

Gordon L. Springate, JR.E.I.C., (B.Eng., elec., McGill, 1955), until recently sales engineer for Reliance Electric and Engineering Limited in Montreal, has been transferred by the company to their Vancouver Branch to assume responsibilities as district manager.

Maurice Lauzon, JR.E.I.C., (B.Sc., geology, Laval, 1949), has joined the staff of Lake Asbestos of Quebec Ltd., as resident geologist. He was formerly geologist and field engineer for Coulee and Headway Mines Limited at Oka, Que.

A. G. Westaway, JR.E.I.C., (B.A.Sc., mech., U.B.C., 1951), has been promoted to plant superintendent with the Clayburn-Harbison Ltd. operations at Abbotsford and Kilgard, B.C. He was formerly acting plant superintendent with Clay Products Ltd. at Medicine Hat, Alta.

J. W. Bouskill, JR.E.I.C., (B.Sc., mech., Manitoba, 1954; M. Bus. Admin., Western Ontario, 1957), is following his career as department supervisor in production at Proctor and Gamble at Hamilton, Ont.

Ivan Brucky, JR.E.I.C., (B.Sc., C.E., Manitoba, 1954), has recently accepted a position as construction engineer in the design and special products branch of the Corporation of the City of Ottawa. Mr. Brucky was formerly associated with the Ontario Department of Highways as project supervisor, and with the Abitibi Power and Paper Co. in Toronto as junior structural engineer.

W. G. Woodcock, JR.E.I.C., (B.Sc., civil, Queen's, 1953), has been appointed district manager for the Toronto and Eastern Ontario division, Air Coils Manufacturing Company Limited, Oakville, Ont.

Most recently, Mr. Woodcock has been associated with Frigidaire Products of Canada Limited as supervisor of sales of commercial refrigeration and air conditioning, also in Toronto and Eastern Ontario.

A. G. Gentle, JR.E.I.C., has resigned his position as mechanical design engineer, development department, of Atomic Energy of Canada Limited in Ottawa, in order to accept an appointment as project engineer for California Pellet Mill Company, at San Francisco.

F/O M. Romanow, JR.E.I.C., (B.Sc., elec., Alta., 1956), is a stations telecommunications officer with the R.C.A.F. at Halberg, B.C. Prior to his transfer to B.C. he was located at the Radio and Communications School at Station Clinton, Ont., for a period of eight months. While there he was engaged in the instruction of communications and armament officer candidates in basic radio and radar theory.

B. S. Fulmore, S.E.I.C., (B.Eng., mech., N.S.T.C., 1957), has accepted the post of assistant plant engineer for Canadian Gypsum Company at Hillsborough, N.S.

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NEWS OF THE BRANCHES

Activities of the Forty-Nine Branches of the Institute and abstracts of the papers presented at their meetings

AMHERST

G. R. Pond, JR.E.I.C., *Sec.-Treas.*

A COUNSELLING NIGHT for the Engineering Students of Mount Allison University, Sackville, was sponsored by the Branch on March 17, 1958. The event was preceded by a dinner meeting for branch members and guests. Approximately one hundred engineering students attended the meeting called to order by Merle Pratt, president of the Mount Allison Engineering Society. Mr. Pratt introduced the panel members. They were as follows: Civil—H. W. L. Doane, vice-president, E.I.C.; manager of the Standard Paving Maritimes, Ltd., Halifax, N.S.; electrical—O. M. Sweetzer, chief engineer, Canada Electric Company, Amherst, N.S.; metallurgy—J. R. Wallace, chief metallurgist, Dominion Steel and Coal Company, Sydney, N.S.; mining—E. Browne, manager, National Gypsum Company Limited, Milford, N.S.; mechanical—Lyle Renner, Public Service Commission, Halifax; sales—J. W. Wilson, maritime manager, engineering, Armco Drainage and Metal Products of Canada Limited, Sackville, N.B.

Mr. Doane acted as panel chairman and after giving a brief talk on the E.I.C., he called upon each panel member to define his particular branch of engineering, to explain the function of an engineer in that branch and to forecast what the future opportunities in that field will be. Each member spoke for five or ten minutes. A general question period followed. Such questions as the following were put forward: What is the future of the mechanical engineer in the field of automation? How could one choose the best branch of engineering to suit his particular abilities? What is the principal trend of the high specialization of electrical engineering? What new metals and alloys are needed for the future? The panel members dispersed about the auditorium to discuss with students specific questions pertaining to a particular field.

BAIE COMEAU

N. Lapierre, JR.E.I.C., *Secretary*

George W. Scott, M.E.I.C, *Branch News Editor*

THE MANICOUAGAN POWER development became the subject of a talk by Charles Miller, project manager of the Canadian British Aluminum Company, Baie Comeau, at a February 28 meeting of the Branch.

Mr. Miller gave a thorough resume of the hydro-electric potentialities of the Manicouagan River and the remainder of his talk dealt with the hydraulic, civil, and construction problems, particularly associated with stage 1, of the Manicouagan development. The value of using models to solve and study hydraulic and civil engineering problems was emphasized, the difficulties and problems of executing a project of this kind during a severe winter was stressed. A detailed description was given of the excavation of a 35 ft. diameter diversionary tunnel and the blasting of the upper and lower access plugs which involved the shifting of 9000 cubic yards of granite and rock barrier with 22 tons of dynamite. Following the talk a 16 mm Kodachrome silent film taken during the construction of stage 1 of the project was shown and commented on by the speaker.

BELLEVILLE

F. E. Moore, M.E.I.C., *Sec.-Treas.*

T. E. Flinn, M.E.I.C, *Branch News Editor*

THE REGULAR MONTHLY meeting of the Belleville Branch on March 10 took the form of a tour of the plant of Pyrotenax of Canada Limited at Trenton, Ontario.

Approximately twenty-five members of the Branch gathered at the plant at 7 p.m. and were taken on a guided tour by company officials. For the benefit of the sightseers sufficient plant staff had been called back to work in the evening to demonstrate the manufacture of a length of pyrotenax cable.

It was first explained that pyrotenax was a French invention, arrived at by French engineers in their search for an electric cable which in case of fire would continue to operate and which ordinarily would neither cause nor contribute to a fire. Pyrotenax Ltd. is a British company which built the Trenton plant in 1953. The plant now employs approximately fifty persons.

A length of cable was built by enclosing a copper rod in a 2 inch diameter seamless tube of copper and packing the tube with magnesium oxide under pressure. The tube is then drawn, after which the copper sheath, insulator, and conductor became a homogeneous mass. Each component maintains its original proportionate size and relative position throughout the remainder of the process until the required finished sheath diameter is reached. Each length of finished cable is given voltage and insulation resistance tests before being shipped.

The tour ended in the plant demonstration room with refreshments supplied by our hosts. The Company officials were suitably thanked for their hospitality by Sid Sillitoe on behalf of the Belleville Branch.

At the Branch executive meeting held on March 10 Mr. J. A. McLaren, Eastern field secretary, successor to Colonel L. F. Grant, who retired recently was welcomed. Mr. McLaren accompanied the Branch members on their tour of the Pyrotenax plant later in the evening.

Dave Pullan, papers chairman for the Belleville Branch, has recently transferred to St. Catharines, Ont. He has been succeeded by Mr. Needham Throop. Mr. Pullan is going to work for North American Cyanamid Ltd. in Niagara Falls.

CALGARY

O. O. Junker, M.E.I.C, *Secretary,*

F. L. Perry, M.E.I.C, *Publicity Committee Chairman*

A DOUBLE HEADER SESSION marked the March 13 dinner meeting of the Calgary Branch with guest speakers at 5.30 p.m. and 8.30 p.m. R. A. Huth, first to mount the platform, discussed the "Pulpwood Industry of Alberta." He is the public relations and training manager of the North Western Pulp and Power Limited, at Hinton, Alta.

"Research and Technical Problems in Highway Construction", received notice when R. H. Cronkhite addressed the group after the dinner. He is assistant chief construction engineer with the Department of Highways, Government of Alberta.

Mr. Huth's talk described the activities and relationships of his company to the economy of the Edmonton-Jasper district. He described the impact of this new industry to the economy of the community of Hinton which has mushroomed from 180 to over 3,000 residents in the past two years. Mr. Huth also made an assessment of the future of pulp and paper in Alberta. He described the plant and answered many technical questions at the end of his talk.

A questionnaire was circulated to determine if the membership would prefer a continuation of the type of programming for technical meetings practised here during recent months. It was almost unanimous that 1958-59 should see fewer general meetings — perhaps a total of four — but that the dinner meeting should be the "meat" in the sandwich of two technical papers at 5:30 p.m. and 8:30 p.m. respectively.

EASTERN TOWNSHIPS

Jean Bourassa, JR.E.I.C., *Secretary*

STUDENTS' NIGHT was a feature of the March 14 meeting and included the presentation of three papers by the University of Sherbrooke students. The first prize of $30.00 was awarded to A. Leroux for his paper entitled, "Power Factor Correction." The paper, "Evolution in Ship Construction," by Camille Blais won the second prize of $25.00. Third prize, $20.00, went to G. Hénault for his work, "Heat Treatment of Carbon Stell."

The jury was comprised of G. M. Dick, R. D. Mawhood, C. Langlois and L. G. Carignan.

Marcel Lafreniere, faculty representative who was responsible for the organization of the meeting made the introductions.

A film on the construction of the St. Lawrence Seaway was shown when the jury retired to make its choice.

The students reported that it is their practice to present two or three films each week on technical subjects.

Students' Night brought the activities of the student section to a close for that term as the time for examinations drew near.

Eastern Townships. Below are, l. to r., Jaques Lemieux, secretary of the faculty of engineering, University of Sherbrooke; Camille Blais, second prize contestant; R. D. Mawhood Branch chairman congratulating Adrien Leroux, first prize; Gilles Henault, third prize, and Marcel Lafreniere, faculty representative.

KINGSTON

D. I. Ourom, M.E.I.C., *Sec.-treas.*

AN INTERESTING EVENING was assured when presentation of five papers was planned for a February meeting of the Kingston Branch. Presented by senior Royal Military College students and Queen's science students the papers were, "Development and Design and Construction of Earth Dams", by O. M. Hodgkins; "Selection of Suitable Gas Turbines for use with Small Free Piston Gas Generators," by R. W. Warkentin; "A Study of a Cut and Fill Stoping Problem at Hardy Mines", by A. J. Patrina; "Thermionic Emission", by P. P. M. Meincke, and "Collapsible Tension Reels for Higher Productivity in Steel Rolling Mills," by D. J. Kilgour.

Vibration problems in a large utility were discussed by Aubrey Edwards, of the Hydro-Electric Power Commission of Ontario at a meeting later in the month. A specialist in vibration problems in the H.E.P.C., research department, Mr. Edwards is in his work concerned with such things as transmission line vibration and the vibrations of building structures due to motors.

H. M. Jones, works manager of the C.I.L. chemicals and agricultural chemicals plants at Hamilton, Ont., on March 18, addressed the Kingston Branch on "Air Pollution in Hamilton, Ont." The subject of air pollution and its reduction has been the subject of discussion in many groups in Hamilton. More than two years ago, the Hamilton-Brantford Branch of the Canadian Manufacturers Association decided to take definite steps toward the definition of this problem. Mr. Jones is a member of the C.M.A. committee associated with the air pollution survey.

Sixty volunteer members of the Hamilton-Brantford Branch of the C.M.A. donated $130,000 to complete an Air Pollution Survey in Hamilton. The Ontario Research Foundation was retained as the agency performing the actual survey.

Two years of the projected three-year program have now been completed and the paper which was presented is a summary of the progress to date.

LETHBRIDGE

R. D. Hall, JR.E.I.C., *Sec.-Treas.*

R. F. Smith, JR.E.I.C.,
Branch News Reporter

HYDRAULIC MODEL TESTING was the engineering subject chosen for the February meeting of the Branch. During his very interesting and informative address, C. D. Smith, of the Prairie Farm Rehabilitation Association, Regina, Sask., showed a number of short films of various hydraulic models used by P.F.R.A., and of several of the dams and structures they have built.

The importance of correct design in order to prevent cavitation and erosion of stilling basins at the entrance of spillways was stressed. Films of the model tests indicated the results of improper design, and of the changes made in the models, which practically eliminated undercutting of the spillways and erosion of the banks of the stilling basins.

The use of the hydraulic jump to dissipate energy and of the effectiveness of various weir structures was also vividly shown.

The experience gained by the use of models has proven effective in practice. Construction and maintenance problems have been greatly reduced, and appreciable financial savings made.

Telephone Industry Innovations

H. J. Childs, switching planning engineer, with the Alberta Government Telephones, at Edmonton addressed the Branch on March 15. The subject of his talk was, "A Forward Look at the Telephone Industry."

A solar powered battery radio was demonstrated and solar batteries will prove valuable for rural telephone exchanges, Mr. Childs stated. Equipment will be miniaturized, keyboard and hands off phones will replace the pres-

ent dial and handset units. A model of a television phone was shown.

Mr. Childs explained in detail the operation of the 3-4 numbering system and of additions required for direct dialing not only on this continent but eventually throughout the world.

LONDON

W. C. Sinkins, JR.E.I.C., *Sec.-Treas.*

George W. Chorley, M.E.I.C., *Branch News Editor*

Dr. A. D. Misener, head of the department of physics, University of Western Ontario, delivered an address to the Branch meeting, March 18. Subject of the talk was, "Education". Dr. Misener began by defining "training" and "education" ,and referred mainly to engineering courses at university level. It was his view that "education" was of little use unless preceded by a basic "training".

Dr. Misener labelled as "woolly thinking" the widely stated view that because the West is behind in missile development, that we should produce more engineers. He went on to develop his thoughts on this very important subject. He was politely heckled at one point by E. V. Buchanan when he was rash enough to refer to the "humanities" without first defining these subjects. Dr. Misener was not in favour of broadening the base of an engineer's education or training to include so called "cultural" subjects.

In his statement that the engineer was better qualified to talk on other subjects, than other professional men were qualified to talk on engineering, Dr. Misener raised a protest from D. Sutton, superintendent of public schools at London. There was a spirited discussion period in which Professor L. S. Lauchland of the University of Western Ontario, Mr. Sutton, Mr. D. J. Matthews and others took part. The chairman of the meeting was R. W. McMeekin.

Although not a large meeting by London standards, it was obvious that all present considered the meeting to have been rewarding.

NEWFOUNDLAND

R. L. Smyth, JR.E.I.C., *Sec.-Treas.*

R. P. Hunt, JR.E.I.C., *Branch News Editor*

THE ANNUAL STUDENTS NIGHT of the branch. was held March 10, 1958. Three engineering students from Memorial University compete for a public speaking prize awarded by the branch. Mr. Duffett discussed "The Alaskan Highway"; Mr. Moore outlined "The Proposed St. John's Harbour Development"; and Mr. G. Moores gave a talk entitled, "Bear and Bull—The Stock Market".

During the student year the engineering faculty holds a weekly seminar. The three speakers who compete at this meeting are chosen by students ballot from all those who speak at the seminars. Meeting are chosen by students ballot from all those who speak at the seminars.

At the conclusion of the three talks, Dean Carew of Memorial University introduced the three speakers and provided brief biographical sketches. A vote was taken among the members to determine the best speakers. G. Moores, declared the winner, will receive the prize at one of the engineering seminars.

The report of the nominating committee, with the slate of officers for the ensuing year, was presented.

Chairman G. Knight announced that the annual dance to take place April 18 at the Old Colony Club.

NIPISSING AND UPPER OTTAWA

R. A. Booy, JR.E.I.C., *Sec.-Treas.*

J. W. Millar, M.E.I.C, *Branch News Editor*

THE ANNUAL STUDENTS' NIGHT and monthly dinner meeting was held recently. This is the evening in which members of the Institute each sponsor a senior high school student who has expressed an interest in engineering as a career. The students were from Algonquin Composite School, Scollard Hall, Sturgeon Falls and Temiskaming High

Schools. Seventy members and guests were present. Mr. J. Chantler of Temiskaming presided.

The speaker, introduced by J. W. Millar, was K. D. Landell of Montreal, president of Adanac Supplies Ltd., and vice-president of Canadian Waugh Equipment Co. Ltd.

Basing his address on "Another Look at Engineering" Mr. Landell placed emphasis in the broader aspects of the fundamental importance of the profession of engineering.

He said that there have been three great turning points in material progress — organized agriculture on which the establishment of settled communities was founded, man's victory over fire which made man virtually independent of climate and led to the industrial era, and thirdly, the advent of atomic energy. The fourth great era is just ahead — it is the crossing of space and interplanetary travel, and may come by the year 2000.

In conclusion, Mr. Landell stated that science and engineering are among the most attractive and exciting careers open to young men and women today, the way is long and hard. An engineer must be a dedicated man and a man of extraordinary intellectual honesty.

Shown together while planning the 3rd annual Architect-Engineer dance, are, left to right, R. Silver, chairman, proceeding committee; H. Chaput, chairman, Ottawa Branch, E.I.C., and G. Pritchard, chairman, Ottawa Branch of the Architects Association.

J. Warburton of Temiskaming thanked Mr. Landell on behalf of the members of the Institute and the students.

OTTAWA

W. V. Morris, M.E.I.C., *Secretary*

A. H. Graves, M..E.I.C., *Publicity chairman*

Five years of Canadian television was the subject discussed at the February 8 meeting of the Branch. J. A. Oimet, general manager of the C.B.C. described the development of the Canadian Television network across Canada during the past five years.

A.I.E.-I.R.E.-E.I.C. Joint Meeting

Dr. R. G. Griffith, chief engineer of the Canadian Overseas Telecommunication Corporation, addressed the Branch on the subject of the "Trend of Overseas Telecommunication Development" at a meeting on February 27. Dr. Griffiths talk was published in the January 1958 issue of the *Journal*.

Computers and Engineering

Dr. K. W. Smillie, of Computing Devices of Canada was guest speaker at a meeting held March 6 when he delivered an address on "Electronic Digital Computers and their Application to Engineering Problems." The clarity with which so complex a subject was dealt was remarkable.

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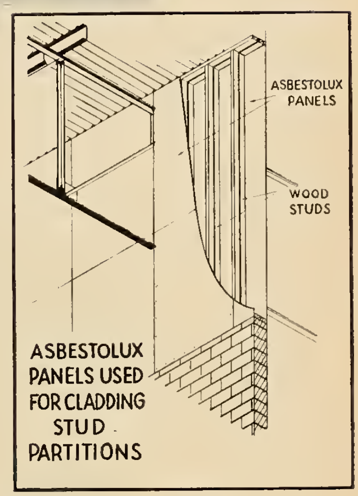

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Dr. Smillie spent two years on operational research with the Defence Research Board. He has been with the data producing department of Computing Devices for the past three years.

Annual Architect-Engineers Dance

One hundred and eighty persons gathered at the Assembly Hall, Lansdowne Park, for a most enjoyable evening of dancing to Clifford Trip and orchestra for the third annual architect-engineers dance. Mr. and Mrs. Gordon Pritchard and Mr. and Mrs. Hector Chaput received members and their wives.

The Forgotten Man

The regular Thursday luncheon meeting, held April 3, 1958 was marked by a talk entitled, "Casey Baldwin, first Canadian Aviator." J. B. Parkin, senior consultant to the mechanical engineering division, N.R.C. in making the address, used as his theme the idea that Casey Baldwin is the forgotten man of Canadian aviation. The flyer was associated with Alexander Graham Bell, and John McCurdy, at Baddeck, N.S. in 1907. He made his first airplane flight in March 1908, in the United States.

SAGUENAY

D. L. Aker, JR.E.I.C, *Sec.-Treas.*

BASIC PRINCIPLES OF LUBRICATION was the title of a film presented to the Saguenay Branch of the Institute and the Corporation of Professional Engineers of Quebec, Saguenay Chapter, by B. H. Miller, manager of sales engineering, Imperial Oil Company of Canada, at a meeting on February 25. After the film showing he discussed points raised in the film and considered automotive lubrication and gasoline as a motor fuel.

At a March 18 meeting of the Branch, and the C.P.E.Q., Saguenay Chapter, G. Riedl, M.E.I.C., of the Aluminum Company of Canada considered the subject of "Aluminum Finishing," Mr. Riedl is a member of the technical department of the Arvida, Que., works, of the company, and specializes on corrosion. He described and evaluated mechanical finishing, chemical and electrochemical brightening, anodizing and other types of finishes and the processes by which they are obtained.

A joint meeting of the E.I.C., the C.I.C., and the C.P.E.Q., Saguenay Chapter on March 25, heard H. McClymont and R. F. D. Collin, in a talk entitled "Get Ready for New Markets." The speakers are members of Alcan's sales development department at Montreal.

The film, "Put this in your Pipe," dealing with a pipe line installation in Alberta was shown.

Professor Kenneth R. Andrews, of the Harvard University Graduate School of Business Administration, who was in Canada for the purpose of giving a series of courses to Aluminum Company of Canada supervisory personnel, graciously consented to address the Saguenay Branch E.I.C., and the Corporation of Professional Engineers, Saguenay Chapter. His talk was entitled, "Top Management's Hope for Engineers."

SAULT STE. MARIE

R. L. Wimperis, JR.E.I.C., *Sec.-Treas.*

"EARLY OJIBWAY HISTORY and legends of the Soo Area", was the title of a talk, which, although not a technical paper brought forth much interest from the Branch meeting held March 28, 1958.

The subject was illustrated by slides and was drawn from the personal experience in the past years of C. B. Lawrence, senior draughtsman, at the Algoma Steel Corporation who visited tribes in this area and as far as the Dakotas. He has been engaged in excavations and in the compiling of Ojibway history and legends. Mr. Lawrence has been adopted into one of the local tribes in a very impressive ceremony in 1953. The Ojibways actually did not settle this area until 1525, coming from St. Lawrence area. The general westward movement of Indians at the time was mainly due to the presence of white men.

SUDBURY

W. J. Ripley, JR.E.I.C., *Sec.-Treas.*

M. D. Head, M.E.I.C., *Branch News Editor*

MEMBERS' NIGHT, held March 13, was celebrated with two speakers. The first of these was a discussion of the history, present status, and future plans of the Sudbury parking authority by Lennox Lane, of Lane, Lane, Lewis and Associates, surveyors, of Sudbury. It was felt that this subject would not command sufficient interest outside Sudbury to merit further mention in the Journal.

Second speaker of the evening, Hugh McGinn, introduced by J. Steele, is an electrical engineer at the Gordon Mines, International Nickel Company of Canada Limited. He graduated from the University of Toronto with a B.A.Sc. degree in 1956. Mr. McGinn's talk was entitled, "Ignition Rectifiers." It is explained that in 1903 Cooper Hewitt found that an electric arc in mercury vapour at a low pressure can possess the property of allowing current to pass in one direction with only a small voltage drop while practically acting as a non-conductor

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Counselling

Roy Switch, chairman of the education committee reported that Lively High School had requested speakers on mechanical and civil engineering for forty-two of the students. Messrs. Robinson and Neill had given the desired talks and had been very enthusiastically received. A further eleven high schools in the district are to be visited for similar talks in the near future, and Mr. Switch requested volunteers for this duty.

UNIVERSITY OF ALBERTA

Student Section

N. H. Crawford, S.E.I.C.,
Branch News Editor

The thirty-fourth annual banquet of the Engineering Students Society was held March 6, bringing to a close the activities of the group for the spring term. Guest speaker for the occasion was a Mr. Ackroyd, of the Department of Extension, University of Alberta. Mr. Ackroyd who is a lawyer, chose the subject of professionalism for his talk.

The Web Memorial award for the best technical paper presented to the Society was presented to Frank King, senior chemical engineering student for his paper, "The Utilization of Sulphuric Acid as a Catalyst in the Alkylation Process." Awards were also presented to J. N. Fry, retiring president of the Society and other executive members.

Bob Pollock, a third year petroleum engineer is president of the Engineering Society and E.I.C. representative.

UNIVERSITY OF BRITISH COLUMBIA

Student Section

Blake Tweddle, S.E.I.C,
Branch News Reporter

The student section of the Education Council at U.B.C. participated in the open house held recently at U.B.C. A booth was set up in the field house to display some of the pictures from the E.I.C. photo display. Different in design, the booth featured a canopy supported by many strings which formed the shape of an hyperbolic paraboloid. The rest of the photos were displayed in the engineering building.

Bob Noble shown attending the E.I.C. booth at University of British Columbia open house.

The booth was designed and constructed by Bill Gill. Several photos from the E.I.C. photographic display. were presented. A canopy formed by a grid of strings outlined an hyperbolic paraboloid. Approximately 80,000 people visited the campus during the two days. Most of these visited the field house where the majority of clubs on the campus had set up displays.

Several student speakers were sponsored by the student section. First year students gave talks on "One Hundred Years of Engineering in British Columbia." Third and fourth year students spoke in connection with their summer essays. The first year essays were judged by the English department.

Essay Public Speaking Contest

Gerald Gatz, a first year student, obtained very high marks in both aspects of the contest to win the first prize of $40.00. It will be published in a later issue of the Journal.

Election of Officers

At the March 14 meeting, the following officers were elected to our executive for the 1958-1959 session:

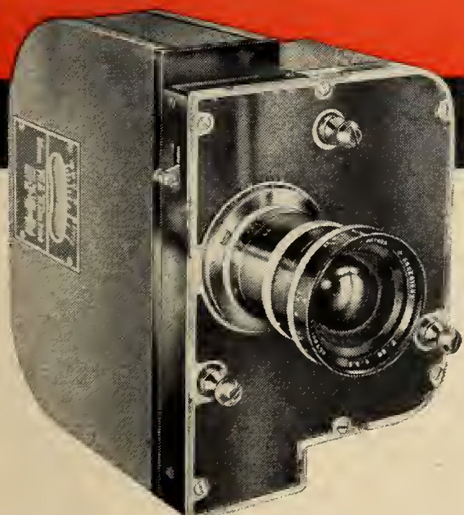
Chairman, Bill Calderwood; vice-chairman and chairman of Toastmaster's Club, Bill Gill; secretary-treasurer, Gero von Dehn; program chairman, Jack Walton; publicity chairman, Murray Brown; field trips chairman, Bill Montador.

UNIVERSITY OF SASKATCHEWAN

Student Section

Raymond L. Blanchette, S.E.I.C.,
Branch News Reporter

Organization of a student's branch was the purpose of a meeting held March 17th on the campus of the University



of Saskatchewan. The following members were elected for office. Brian MacFarlane, chairman, Raymond Blanchette, secretary-treasurer and Dave Burke, program representative. The branch gained the approval of the Saskatchewan Branch, Regina section, on March 21. Approval from E.I.C. headquarters is still awaited.

Some of the rules which the new Branch aims to follow are to interest the student in the professional activities of the Institute and association and to advance his technical knowledge.

It will sponsor and promote the following: monthly technical meetings during the academic year, noon hour showing of technical films, students' paper nights, an annual drive for membership and others.

VANCOUVER

A. D. Cronk, JR.E.I.C., *Secretary*

J. J. Kaller, M.E.I.C., *Publicity Chairman*

THE STRUCTURAL SECTION of the Vancouver Branch held a meeting February 18, during which S. A. Sanderson, M.E.I.C., of Sanderson and Company, consulting engineers delivered a paper on the Nelson bridge design and construction with particular emphasis on the main pier foundation. Numerous slides accompanied this well-attended lecture.

On March 18, the Structural Section was the host to the general membership of the Branch during which a film on the construction of the 24 mile long Pontchartrian Bridge was shown. This bridge which is the longest one in the world is constructed on prestressed cylindrical Raymond piles. Mr. R. L. Nordlund, Ph.D., M.E.I.C., manager of the Raymond Concrete Pile Company answered numerous questions amplifying some details of that structure.

Some sixty engineers and their families recently took part in a conducted tour of the Vancouver aquarium.

VANCOUVER ISLAND

J. A. Cowlin, JR.E.I.C., *Sec.-Treas.*

H. F. Coupe, E.I.C, *Branch News Editor*

THE DEAS ISLAND TUNNEL was the subject of a talk given to Vancouver Island engineers by Norman D. Lea, vice-president of the Foundation of Canada Engineering Corp. Ltd. on March 19. Mr. Lea began his talk by outlining the present and future traffic requirements in the Vancouver area which led to the decision to build a tunnel under the Fraser River at the Deas Island location. It was pointed out that this will be the first tunnel of its type on the North American continent, being of rectangular cross-section supported on sand fill jetted under the tunnel elements to form a uniform and reliable support. The speaker continued with a description of the method of constructing the concrete tunnel segments in a drydock adjacent to the site from which they were floated out into the river and sunk in position. The method used to connect the segments under water and the jetting of the sand fill under the tunnel elements was explained followed by a description of the protective measures taken to safeguard the tunnel against river scour and uplift. The talk was illustrated with slides and was followed by an interesting question period.

Twenty-two engineers travelled to the Deas Island Tunnel site near Vancouver on March 22, to be guests of the Foundation of Canada Engineering Corp. Ltd. on a tour of the project. The tour began with an inspection of the drydock where the tunnel elements were constructed which at the time was flooded and contained the last two elements, the remainder having been placed in the river bed. From here the party visited the fitting out jetty and the construction area where concrete mats for scour protection of the tunnel were being poured. The north tunnel approach, of open

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cut type supported by concrete retaining walls, was nearly complete. By descending the approach section, the party was able to enter and inspect the first two tunnel segments in position on the river bed.

Following the tour light refreshments were provided at the construction office.

WINNIPEG

C. S. Landon, M.E.I.C., *Sec.-Treas.*

D. G. Curiston, *Section Reporter*

The annual meeting of the Electrical Section which was held on January 8, took the form of a dinner meeting. Attendance was increased over last year's figures.

A film produced by the The Quebec Hydro Electric Commission and available through the courtesy of Canada Wire and Cable, entitled "Beneath the Wide St. Lawrence" was shown. This film dealt with the manufacture and laying of the 69,000 volt, 3 phase power cable across the St. Lawrence River at Rimouski, Que. Its function is to supply power to the residents of the Gaspe area. The cable is now in operation.

New Executive

The new executive selected for the 1958-59 season are as follows: P. Shane, past chairman; S. Eggertson, chairman; G. Flavell, vice chairman; A. Oddleifsson, executive member; and J. Crawley, executive member.

Commissioning Brandon Plant

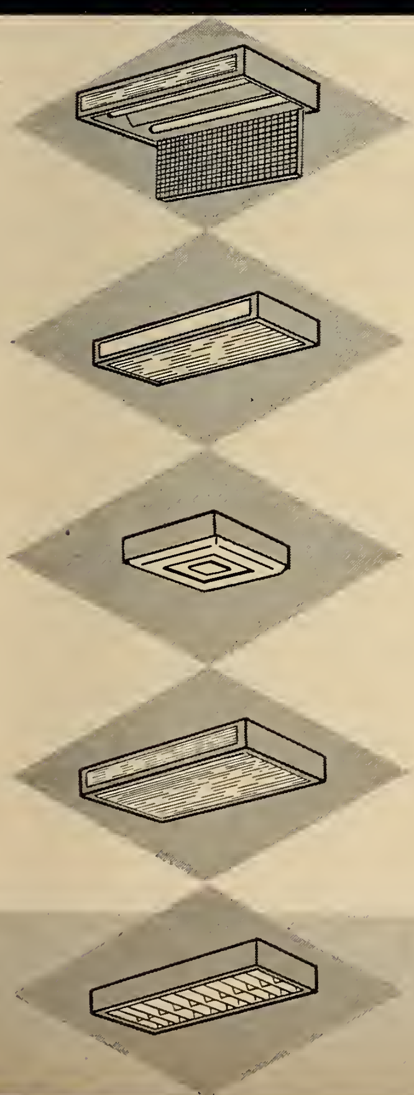
S. Irving, superintendent of the Brandon steam generating station, gave a talk on the commissioning of the Brandon plant, comparing it with one at Poole, England.

The Brandon plant consists of 4 — 325,000 lbs./hr. boilers fired at 625 p.s.i. and 825°F using No. 2 diesel fuel for starting and Souris lignite as the main fuel. The boilers are designed to burn natural gas as an alternative. There are 4-33 M.W. turbines to be installed. These are single cylinder units with hydrogen cooled alternators. The flow of the Assiniboine river is somewhat unreliable and for this reason a cooling tower has been constructed so that now the river has only to supply make-up water. The tower which is 385 feet long and 70 feet wide and is cooled by 24 cooling fans, is designed to drop the water temperature 30°F. The circulating pumps are capable of handling 4,500,000 gallons of water per hour. All water used in the plant must be treated. Coal is brought in by rail from the Souris field. Handling equipment at the plant will handle 400 tons/hr. When the station is in complete operation it will be necessary to handle between 50-60 cars a day or one car every 8-10 minutes. Dust and ash is handled on the wet system and is pumped out to a dyked area where the water drains back into the river. The first unit was put on the system on November 26/57 and the second on January 11/58. Two more units will be completed during the summer of 1958.

At a march 6 meeting the Electrical section heard J. Adamson, technical sales superintendent from Bepco Canada Limited, Montreal, present a talk on variable speed drive control.

Mr. Adamson dealt with the various means of speed control, particularly in connection with paper machines. The three methods of control are electronic, magnetic and direct drive. Down time was dealt with at great length by the speaker and there doesn't seem to be much to choose between the methods of control as far as influencing down time is concerned. Down time is more liable to be mechanical than electrical. Mr. Adamson showed several slides which demonstrated the processing of newsprint.

The annual wind-up of the seventh section was held in the form of a smorsgasbord and dance at the Vasalund in Charleswood. About 110 people attended.



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News of Other Societies

Canada-U.S. Chemical Engineering Conference

One of the main achievements of the Canada-U.S. Chemical Engineering Conference held in Montreal, April 20-23, 1958, was to bring together the views and opinions of the United States, Canadian, and European leaders in the chemical engineering field—"European" including, in this event, a Russian delegation. To some extent, the Canadian participation can be seen as an extension of the frequently occurring Canadian role of "interpreter" between the United Kingdom and Commonwealth and the United States and between the greater and smaller powers.

Sponsors of the conference were the American Institute of Chemical Engineers, and the Chemical Institute of Canada, Chemical Engineering Division.

Of the total registration of 1,370, some 550 delegates were from the United States. There were eight European delegates: Dr. Paul Ferraro, Belgium, Dr. R. Holroyd, London, J. J. Desportes, Paris, Dr. Karl Winnacker, Frankfurt, West Germany; Prof. Giulio Natta, Milan, Italy; Professor Nikolai N. Melnikov of Moscow, and Dr. Valentin B. Aleskovskij of Leningrad, and Mr. Sergej F. Filipytchev of Moscow.

The European speakers gave a review of the chemical industry on that continent, dealing with such subjects as: the policy of France toward an atomic energy program; the increase in production by Britain's chemical and allied trades in the past ten years; the economic position of the West German chemical industry; the post-war strides in Italy's chemical industry; the advantages to industry of the Benelux economic pattern.

Prof. Melnikov spoke about the rapid development in the U.S.S.R. chemical industry envisaged in the coming years. Dr. Aleskovskij explained the Soviet educational system which accommodates 700,000 students in 750 schools of higher learning. The Soviet participation was the first of its kind in North America.

The American and the Canadian speakers brought up to date the development in the chemical industry on this continent. In a session on future sources of power, speakers from the Atomic Energy Commissions gave the latest data on heavy water reactors.

In discussions the main concerns of the industry were reviewed, in sessions on The Investor and Chemical Industry Management; Chemical Engineering Education in the U.S. and Canada; Career Opportunities in Chemical Engineering. Technical information was made available in symposia and papers on the subjects of mineral processing, high temperature materials for jets and rockets, fluid mechanics, noise in the industry, chemical engineering, and construction techniques, heat transfer, and others.

The Hon. J. Paul Beaulieu, Minister of Industry and Commerce of the Government of Quebec, gave the welcoming address.

W. M. V. Ash, president of Shell Oil Company of Canada, Limited, speaking at a luncheon during the conference, gave a history of the petrochemical industry, comparing Canadian and American progress in developing new products.

The Hon. Lester B. Pearson, M.P., spoke on international affairs at a luncheon on April 22, discussing the political signficance of control of nuclear power.

International Conferences, September, 1958

Fifth UPADI Convention

The fifth convention of the Union of Panamerican Engineering Associations (UPADI) will take place in Montreal, Canada, at the Queen Elizabeth Hotel, September 2-6, 1958.

The Engineering Institute of Canada (2050 Mansfield Street, Montreal) as the Canadian member of UPADI, is participating actively in the organization of the meeting.

World Power Conference, Canadian Meeting

The Canadian Sectional Meeting of the World Power Conference will be held in Montreal from September 7-11, 1958. It is being arranged by the Canadian National Committee of the World Power Conference (Room 150, 500 Wellington Street, Ottawa 4, Canada).

Theme of the Canadian Sectional Meeting will be "Economic Trends in the Production, Transportation and Utilization of Fuel and Energy."

The four-day meeting will afford delegates an opportunity to visit industrial enterprises and construction projects in the Montreal area. There will also be a number of post-conference tours.

Application forms for participation are required to be in the hands of the Canadian Secretariat not later than July 1, 1958.

Sixth International Congress on Large Dams

The Sixth International Congress on Large Dams will be held at the Hotel Statler, New York City, from September 15-20, 1958.

The United States Committee on Large Dams has invited all member countries of the International Commission on Large Dams to participate in the congress and in the study tours which will follow it.

One study tour is sponsored jointly by the Canadian National Committee of the World Power Conference and the U.S. Committee on Large Dams. This tour will leave Montreal on September 11 and will include visits to the St. Lawrence Seaway Power Project near Cornwall, to Niagara Falls, and to the Shippingport Nuclear Energy Plant near Pittsburgh, Penn.

Inquiries on the part of Canadians relating to the Sixth Congress should be addressed to the Canadian National Committee (Secretary, Dr. R. L. Hearn, Glen Nevis, Queenston, Ont.).

Canadian Building Conference

Administration of building regulations was one of the topics discussed at the Ninth Canadian Building Officials Conference held in Ottawa early in April. More than 80 delegates attended the three-day meeting sponsored by the Associate Committee on the National Building Code of the National Research Council of Canada.

Reports were given on the technical work leading to the development and improvement of the Code, an advisory document issued by the associate committee and designed for use by municipalities throughout Canada. At present 364 municipalities have either adopted the Code or are making wide use of it, indicating a large degree of success in achieving uniformity of building regulations in Canada.

Stanley H. Pickett of the Community Planning Association of Canada spoke on Rehabilitation of Buildings in the Urban Renewal Process. It was emphasized that building officials play an important part in maintaining standards in building and that by this means, urban decay could be checked, making urban renewal or slum clearance unnecessary in some cases.

The delegates visited Central Mortgage and Housing Corporation and the information office of the Federal District Commission where Walter Bowker

described the National Capital Plan and the operations of the Commission. The Conference concluded with a tour of the National Capital region.

Copies of the proceedings of the conference can be obtained by writing to the Secretary, Associate Committee on the National Building Code, National Research Council, Ottawa, Canada.

British Scientific Instruments Mission

During the month of March, members of the Scientific Instrument Manufacturers' Association of Great Britain visited Canada in response to the invitation of the Canadian Trade Mission which visited Britain late in 1957. It was the purpose of this body to explore ways that Britain could increase her exports to Canada without entering into competition with Canadian manufacturers.

The instrument field is one which fits the requirements, since 90 to 95% of the instruments used in this country are imported, and of these imports probably 90% come from the United States.

The team of representatives of British manufacturers visited university laboratories, the hydro-electric power plants at Niagara Falls, Ont., and hospitals, aircraft, electronic and chemical industries and oil refineries. They spoke to the press in Toronto, Montreal and Ottawa.

Particular instruments or types were not described, but mention was made of the British instruments used to record the natural phenomena on the Fuchs expedition in the Antarctic, and of the instrumentation of the ZETA project at Harwell.

Head of the mission was L. A. Woodhead, director of Cossor Instruments Ltd., member of council of the Scientific Instruments Manufacturers Association. Other members were: D. A. Pitman, sales director; Electronic Instruments Ltd.; V. A. Sheridan, director, British Physical Laboratories; D. R. Stanley, director, Hilger & Watts Ltd.; W. H. Storey, director, Unicam Instruments Ltd.; J. R. Waite, director, L. Oertling Ltd.; and R. H. Rybb, correspondent to the group.

Calendar

Canadian Aeronautical Institute

Annual general meeting, at Toronto, Ont., May 26-27.

The Royal Society of Canada

Conference in Edmonton, Alta., June 2-4.

Mechanical Engineering Congress

Seventh International Mechanical Engineering Congress, Scheveningen, Netherlands, June 2-7.

Metallurgical Research

International Congress on metallurgical research, Liege, Belgium, June 17-29, 1958.

Chemical Engineering

Institution of Chemical Engineers, symposium on the organization of chemical engineering projects, London, Eng., June 24-26.

Welding Assembly

The International Institute of Welding, annual assembly, Vienna, June 30-July 5, 1958.

American Institute of Chemical Engineers

Fiftieth anniversary, Golden Jubilee celebration, June 22-27, 1958. Theme, "A Look to the Future." For further details write: Joseph I. Savoca, Socony Mobil Oil Company, Paulsboro, N.J.

American Society of Civil Engineers

Convention featuring water, wood topics, Portland, Ore., June 23-27, 1958. Write: A.S.C.E., 33 West 39th St., New York 18, N.Y.

Management Training Institute

The eighth annual Management Training Institute, sponsored jointly by the School of Business Administration, University of Connecticut, and the Northwestern region Society for Advancement of Management, also Conn. U., June 20-29, 1958. Write: Dr. A. D. Joseph Emerzian, University of Connecticut, Storrs, Conn.

Canadian Electrical Association

The sixty-eighth annual convention of the Canadian Electrical Association, Banff Springs Hotel, Banff, Alta., June 30, July 2, 1958. Write: managing director, Room 320, Tramways Bldg., Montreal 1, Que.

Comite National de l'Organisation Francaise

A work report of the Eleventh International Congress of the Scientific Organisation, Paris, June 24-28, 1958, to be published by C.N.O.F., the monthly publication of the organization. A number of reports translated to English. Write: C.N.O.F., 57, rue de Babylone, Paris VIIe.

American Society of Heating and Air-Conditioning Engineers

Semi-annual meeting, Pick-Nicollet Hotel, Minneapolis, Minn., June 23-25, 1958. Write: W. M. Vidulich, 62 Worth St., New York 13, N.Y.

Canadian Institute of International Affairs

Twenty-fifth annual study conference on Canadian-American Relations, University of Alberta, Edmonton, June 7, 8, 1958. Write: Canadian Institute of International Affairs, 230 Bloor Street West, Toronto.

The Society of the Plastics Industry, Inc.

The S.P.I. Midwest section conference, French Lick-Sheraton Hotel, French Lick, Indiana, June 26-27, 1958.

American Society for Testing Materials

The 61st Annual meeting of the A.S.T.M., to be held at Hotels Statler and the Sheraton-Plaza, Boston, Mass., June 22-27, 1958. Write: Asst. Secy., 1916 Race Street, Philadelphia 3, Pa.

Society of Automotive Engineers, Inc.

S.A.E. Summer meeting, Chalfonte-Haddon Hall, Atlantic City, N.J., June 8-13. Write: S.A.E., 485 Lexington Ave., New York 17, N.Y.

Society of Naval Architects and Marine Engineers

Annual spring meeting, Chamberlin Hotel, Point Comfort, June 2-3. Chairman, P.R. Committee, S.N.A.M.E., c/o American Bureau of Shipping, 45 Broad St., New York 4, N.Y.

National Society Professional Engineers

Annual meeting, Chase-Park Plaza Hotels, St. Louis, Mo., June 11-14. Write: K. E. Trombley, 2029, K. St., N.W., Washington 6, D.C.

International Institute of Welding

Annual meeting, I.I.W., Vienna, June 20-July 6. (see Journal, Feb. issue, p. 118). List of welding displays and conferences: Welding in the Chemical Industry—Great Welding Invention of the Deutscher-Verband fur Schweiss-Technik, E.V., Mannheim, June 18-20; I.S.O. General Meeting, covering such topics as steel, cast iron, copper and copper alloys, Harrowgate, June 9-21; International Electro-Technical Commission General Meeting, Stockholm, July 8-18. Write: W. R. Stickney, exec. secy., Canadian Council International Institute of Welding, 7 Pleasant Blvd., Toronto.

Notices

Gray Iron Founders' Society

The 1958 design contest sponsored annually by the Gray Iron Founders' Society, Cleveland, Ohio, offers recognition to designers and engineers of gray and ductile iron castings, and an award of $500.00, first prize. Deadline for the contest is June 20, 1958.

Write: Gray Iron Founders' Society, Inc., National City, East Sixth Bldg., Cleveland 14, Ohio.

Jet Piercing is a development of Linde Air Products Company, Division of Union Carbide Canada Limited

LIBRARY NOTES

ADDITIONS TO THE INSTITUTE LIBRARY • REVIEWS • BOOK NOTES • STANDARDS

BOOK REVIEW

HYDRODYNAMICS IN SHIP DESIGN

One of the most complete works of its field, this 2 volume set presents a most up-to-date theoretical and practical treatment of ship hydrodynamics. It is sponsored and endorsed by the Society of Naval Architects and Marine Engineers, as well as by the Bureau of Ships, Department of the Navy.

The authors are Captain Harold E. Saunders, U.S.N. (retired) and his staff, who devoted eight years exclusively to the preparation of the first two volumes and who are at present working on a third volume. The third volume is expected to be completed in 1961, and will deal with manoeuvring, towing, natural waves and motion in waves.

Captain Saunders is exceptionally qualified to write a ship hydrodynamics work of this magnitude, having spent a life-time engaged in all phases of ship design, construction and theory. From the time of his graduation from the U.S. Naval Academy, where his standing was the highest in the Institution's history since the graduation of his eminent predecessor, Admiral Taylor, to the present time, his career has included many outstanding accomplishments in this field. Not the least of these was the award to Captain Saunders of the David W. Taylor Gold Medal for notable accomplishments in Naval Architecture.

The two volumes are arranged in four parts. The first two parts, which appear in the first volume, describe the useful aspects of liquid flow and the phenomena associated with the motion of the simple ship and its elements in a liquid, making extensive use of a graphical representation. This is supplemented by a description, with diagrams, of the nature and results of the flow around propulsion devices, control surfaces and the like. The general concepts of flow are expanded in Part 2 and made more specific. They include the phenomena pertaining to motion of water around ships, propellers and appendages. The application of fundamental principles to the problems of flow, pressure and frictional drag about actual ship forms and their many parts is explained in the endeavour to show how the component parts of the whole, individually and collectively, affect and influence its resistance, propulsion and manoeuvring characteristics.

In Part 3 (Vol. 2) the liquid flow phenomena and ship motions are treated in a quantitative manner. Those formulas which are useful in calculations and quantitative prediction of the behavior of a ship and its parts are presented with sufficient background to give them meaning and ensure their proper use. Most formulas given are supplemented by practical examples.

Part 4 (Vol. 2) contains rules, principles and source information for data in the preliminary design stage of ships and their appendages and propulsion devices, insofar as their form, propulsion, motion and other hydrodynamic characteristics are concerned. A practical example of the design of the hull form, the propellers and the appendages of a ship is included to illustrate how the knowledge gained in the book and its references is applied.

The text concludes with an actual preliminary hydrodynamic design of a large merchant ship, including the design of its propeller and two alternative types of motorboat to be carried by the large vessel as a tender. Complete data and explanation is given of each step in the designs, and the latest methods of design procedure are used. Finally, the design of the merchant ship was tested in the David Taylor Model Basin and complete results and analysis are given for the self-propelled and towed tests.

In general, Volume 1 presents theory and description of hydrodynamic effects, while Volume 2 presents data and formulae and shows how application is made to specific design problems. In this approach, an extremely complete coverage has been obtained of almost all types of hydrodynamic effect likely to be met with in contemporary ship design. The accumulated findings of research centres and model testing basins the world over have not been ignored. The student and practising naval architect will also find a comprehensive and unusually complete bibliography for use in extending his study. (H. E. Saunders. New York, Society of Naval Architects and Marine Engineers, 1957. 2 vols., $30.00.)

J. G. German, M.E.I.C.

THE ENGINEERING INSTITUTE LIBRARY

The publications mentioned in these Notes are now available in the Library. Members of the Institute may borrow books, periodicals, pamphlets, etc. from the Library. The loan period is two weeks, excluding time in transit, and two items may be borrowed at one time. Library hours are: Monday to Friday: 9 a.m. — 5 p.m.; Saturday, 9 a.m. — 12 noon.

Because of a recent change in policy, publications (except periodicals published by other engineering societies) may no longer be purchased through the Library. If members have difficulty obtaining material locally, it is suggested they write to the Library, and the enquiry will be forwarded to an appropriate bookseller. For further information write to the Librarian.

BOOK NOTES

Prepared by the Library, The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

*AMERICAN POWER CONFERENCE PROCEEDINGS, VOLUME XIX, 1957

Papers emphasizing broad aspects of technical development. A wide variety of topics is presented including steam and gas turbines, industrial power plants, condensers and feedwater circuits, extra high voltage systems, electrical distribution, computers and network analyzers, nuclear energy, and water technology. (Chicago, Illinois Institute of Technology. 746p., $8.00.)

BASIC TELEVISION

Developed in conjunction with the New York Technical Institute, this is a text suitable for study at home or in the classroom. It presents the basic theory, operation and circuitry of black and white television in a simple form, with many illustrations and diagrams. The volumes cover: the transmitter; the receiver; antennas and transmission lines;


at last... the
BLAST

receiver circuits. (Alexander Schure. New York, Rider, 1958. 5 vols., $10.00 a set, $2.25 per vol. Also available bound in 1 vol. $11.50.)

BRIDGES AND THEIR BUILDERS, REV. ED.

This is the history of the science of bridge building from man's first crossing of a stream on a fallen log to the designing by Mr. Steinman of the Mackinac bridge.

The first section of the book describes primitive bridges, and the gradual development of the art of bridge building leading to the achievements of the Romans, the middle ages and the Renaissance.

Mr. Steinman examines the changes made in the science by the use of iron, steel and concrete, and discusses the work of such men as Rennie, Stephenson, Latrobe, Eads, the Roeblings, Baker and Fowler, and many others.

He describes the various types of bridges; arch, cantilever, suspension, tubular, bascule, vertical lift, truss, etc., and examines in detail some bridges built in this century.

Although essentially written for the layman, this is a most interesting work by an authority on the subject. In this revised edition, corrections have been made, and the text brought up to date, to include mention of European bridges destroyed during the war, and those built both in Europe and on this continent since.

One criticism. Where revisions have been made in the text, or new material incorporated, a smaller type-face has been used, and the sudden transition in the middle of a sentence is most disconcerting. (D. B. Steinman and S. R. Watson. New York, Dover, Toronto, McClelland and Stewart, 1957. 401p., pa. $2.15.)

BUILDING AND PUBLIC WORKS ADMINISTRATION, ESTIMATING AND COSTING, 5TH. ED.

The fifth edition of this book to appear in eleven years is a useful work on estimating, costing and administering large-scale building and civil engineering works, and although it is British, much of the material is applicable in this country.

The first nine sections deal with various aspects of costing and administration: head office and site charges; costing; tendering; how to use the estimating tables; site administrative staff; organizing the work; and plant and labour.

The remaining sections contain detailed information on the costs of specific items of work; bricklaying, carpentry, concreting, excavation, pile driving, etc. (Spence Geddes, rev. by E. Drury. London, Newnes, 1957. 288p., 42/-.)

°BUILDINGS FOR INDUSTRY

A selection of recent industrial building designs which are accompanied by studies on the trends and factors prevalent in current practice. The philosophy and practical needs of the company are used to explain choice of site, plan, lighting, colors, location of loading docks, rail spurs, and employer facilities. Types of buildings studied include warehouses, light industry, consumer goods, manufacturing laboratories, utilities and service industries, and heavy industry. (New York, F. W. Dodge, 1957. 309p., $9.75.)

°CONTRACTS, SPECIFICATIONS, AND LAW FOR ENGINEERS

Included is an explanation of the basic principles of the law of contracts; a discussion of the application of these principles to construction contracts in particular, with data on the preparation of specifications; a consideration of the various fields of law of special interest to the engineer. The authors attempt to state legal principles simply and clearly rather than quote extensively from involved court decisions or complicated legal documents. (C. W. Dunham and R. D. Young. Toronto, McGraw-Hill, 1958. 550p., $12.00.)

°DYNAMIC INSTABILITY

Studies the general problem of dynamic instability and in particular self-excited oscillations arising from motion. Introductory material on simple harmonic oscillations and conservative systems is followed by a description of non-

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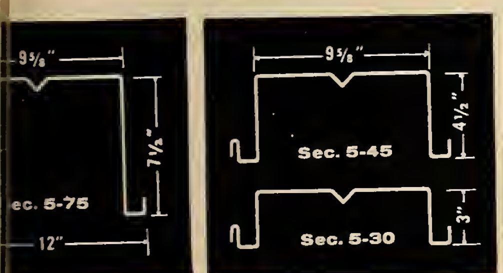
new freedom in roof design. Since its introduction two years ago, Robertson's Section 5 Long-span Q-Deck has successfully filled requirements for economical long spans in the construction of schools, supermarkets and other types of buildings. Now, two new variations are added to further increase cost-savings and add to design latitude.



cross-section of Section 5-45 and 5-30 is same as ard long-span Section 5-75. Only the vertical nsions are different.

Note drawing to left. Basic cross-section is the same—only the vertical dimensions have been changed. Underside of the decks retain the same appearance, making it practical to combine all three types for greater economy for varying load and span requirements.

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ADDRESS __________ CITY __________ PROV __________ conservative systems with one or several degrees of freedom. The rest of the book concerns itself with practical problems, such as the directional instability of automobiles, the instability of suspension bridges under wind, and the flutter speeds of aircraft wings. (Y. Rocard. New York, Ungar, 1957. 227p., $9.50.)

*ELEMENTS OF WATER SUPPLY AND WASTE-WATER DISPOSAL

Emphasizes the scientific principles underlying engineering applications. The first half of the book deals with the collection and distribution of water and the collection and removal of waste water, while the second half takes up the behavior of natural waters and the treatment of water and waste water. Appendices include a collection of supplementary problems and tables to simplify computations. (G. M. Fair and J. C. Geyer. New York, Wiley, 1958. 615p., $8.95.)

ENGINEERING HYDROLOGY

A concise treatment of modern hydrology, taking a primarily quantitative approach, and using runoff as its central subject. Both surface-water and ground-water runoff are considered, and their interrelation shown. Other topics are shown in relation to runoff.

The subjects covered are: precipitation and snow and snowmelt, and their analysis; subsurface water; infiltration; hydraulics of wells; stream-flow data; analysis of runoff data; net storm rain; and peak discharge and flood runoff.

Both bibliographies and problems are included in this text which is intended both for practising engineers whose main interest is not hydrology, and for students. The author is a professor of civil engineering at the University of Southern California. (S. S. Butler. Englewood Cliffs, Prentice-Hall, 1957. 356p., $7.00.)

ENGINEERING MATERIALS HANDBOOK

A detailed reference book on engineering materials for engineers, designers, students, architects and purchasing agents, with the emphasis placed on the fabricated forms of materials, their physical and mechanical properties, their adaptations, advantages, limitations, competition against each other, protection against deterioration, and the increase in their stability to withstand use and abuse.

The material was prepared by 150 specialists, and is divided into four parts, the first of which covers metals, ferrous, stainless steels, base and precious metals, speciality ones used primarily as alloys, liquid metals and paying particular attention to the uncommon metals. Also covered in this section are powder metallurgy, fusion, welding, electrical uses, dies and other tools, and coatings.

The second section deals with inorganic materials; bricks, clays, refractories, silicas, glasses, stone, concrete, etc. The organic materials are included in the next section; tars, pitches, asphalts, waxes, paints, rubbers, plastics, etc.

The final section discusses permanence and the prevention of failure; corrosion and anti-corrosives, cracking, brittle and mechanical failure, high temperature applications, etc. There is a lengthy bibliography on the sources of information on engineering materials. (Ed. by C. L. Mantell. Toronto, McGraw-Hill, 1958. Various paging, $25.80.)

*ENGINEERING PRECISION MEASUREMENTS, 3RD ED.

This book provides a general survey of the more important methods of precision measurements employed in engineering workshops, and describes in detail some of the more widely used ones from the viewpoint of the user in the gauge room, inspection department, toolroom, and machine shop. For some cases the principles upon which the instrument is based are given, and typical examples are described. New chapters in this edition cover slip gauges, surface finish, straightness and flatness measurements, interferometive methods, and advances in automatic gauging and work sizing. (A. W. Judge. Toronto, Ryerson, 1957. 447p., $13.00.)

*FATIGUE OF AIRCRAFT STRUCTURES

Six papers dealing with the problems, methods of test, and latest developments in the fatigue testing of aircraft structures. The material contained is of interest to metallurgists and mechanical

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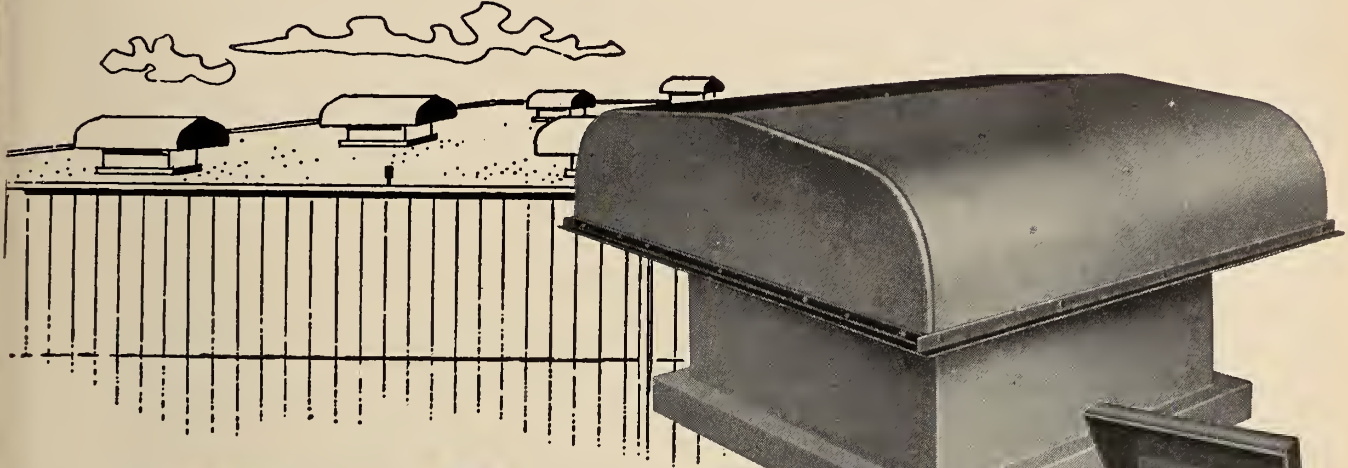


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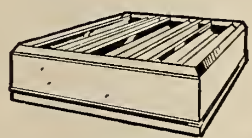

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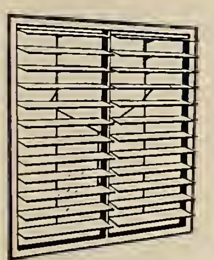

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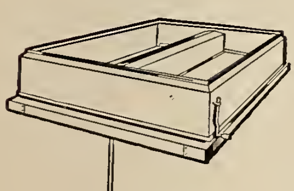

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All unsightly supporting stays and guys have been eliminated from 'Low-Line' ventilators. Instead, its well-proportioned hood is internally braced and anchors securely to any suitable 4″ curb by means of its integral base. Available either as a gravity unit for exhaust or powered for both intake and exhaust, 'Low-Line' is the latest word in appearance and utility.

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In addition, Eastern Steel supplies a complete line of Swartwout ventilators, including those illustrated at left. Write for further information on these ventilators and for your free copy of the booklet 'A Guide to Estimating Ventilating Requirements.'

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engineers working with fatigue problems as well as to aircraft designers. (Philadelphia, American Society for Testing Materials, 1957. $2.75. (S.t.p. no. 203.)

*HOCHDRUCK-HEISSDAMPF

A text on high-pressure, superheated steam which reviews German, American, Russian and Czech experience in the field. Major topics covered are as follows: materials problems in a superheat installation; phenomena during the production of saturated steam; behavior of steam in the superheater; control of steam purity; the superheater, its accessories, and its production during the starting-up; effect of plant conditions on superheat temperature; and the influence of changes in temperature on the life of superheater coils. (R. Dolezal. Essen, Vulkan-Verlag, 1957. 338p., DM 48.)

*INDUSTRIEOFENBAU

A new, comprehensive treatment of the principles and construction of industrial furnaces. Although the most extensive consideration is given to metal-treating furnaces, other types are covered as well, including drying ovens, baking ovens, infrared devices, low-pressure gas burners, etc. A list of book titles is appended, and periodical literature references are included as footnotes or as chapter bibliographies. (J. H. Brunklaus. Essen, Vulkan-Verlag, 1957. 383p., DM 46.)

*JAHRBUCH DER ELEKTROWARME

The first of a proposed series of volumes summarizes current knowledge in the various fields of application of electric heating. Each of the sixteen sections has one or two long articles plus brief German abstracts of pertinent reports from the third Intl. Congress on Electric Heating, 1953. The fields covered include ferrous and nonferrous metals; wood, plastics, and other nonmetallic materials; drying and hardening processes; furnaces and auxiliary equipment; domestic and farm electric heating; power supply; special industrial uses. (Ed. H. Muller. Essen, Vulkan-Verlag, 1956. 726p., DM 64.00.)

LANDSLIDES AND ENGINEERING PRACTICE

Designed for practical use, this volume contains information for the engineer who needs to recognise, avoid, control, design for, or correct the more important types of landslide movement.

The first section of the book is entitled "Definition of the problem" and covers the economic and legal aspects of landslides, the various types of landslide, and their recognition and identification, airphoto interpretation, and field and laboratory investigations.

The second section deals with the solution of the problem, and summarizes the methods known to have been applied to the prevention and control of landslides, and the methods of making stability analyses and their use in the solution of design problems.

The book has been compiled by the members of the Committee on Landslide Investigations of the Highway Research Board, and stresses the problem in relation to highways and railroads. The information in the book is, however, applicable to landslides occurring in other situations. There are illustrations throughout of actual slides and their solution, and references for further reading are included. (Ed. by E. B. Eckel. Washington, Highway Research Board, 1958. 232p., $6.00.)

*LOGICAL DESIGN OF DIGITAL COMPUTERS

Describes methods and techniques for the design of general or special purpose computers by use of synchronous circuit components. The book discusses in detail the Veitch Diagram method of simplification of Boolean equations; the difference-equation approach to memory elements; the Huffman-Moore model of digital systems; the complete solutions to flip-flop input equations. A mathematical introduction to Boolean algebra is included. (M. Phister, Jr. New York, Wiley, 1958. 408p., $10.50.)

MANAGEMENT FOR ENGINEERS

Statistics show that eventually approximately 40 per cent of professional engineers become managers, and even those who do not themselves become managers come more and more in contact with management.

This book is an attempt to explain to engineers the workings of manage-

Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

Pressure Pipe Company Changes — The Pressure Pipe Company of Canada Limited announce the following executive changes: J. C. Smith, chairman of the board; P. M. Draper, president; F. E. Miller, vice-president and director.

Atlas Copco—S. H. Ekefalk and E. Ryd have been appointed deputy managing directors of Atlas Copco A.B., manufacturers of compressed air equipment.

Election to Board of Directors — The Hon. F. M. Ross, lieutenant governor of British Columbia, has been elected to the board of directors of Canada Wire and Cable Company Limited.

Bell Telephone Company — A. F. Branscombe has been appointed by the Bell Telephone Company of Canada as chief engineer of the company's toll area with headquarters in Montreal.

Senior Sales Appointment — Dominion Bridge Company Ltd., announces the promotion of K. B. Martin as engineer-in-charge plate and tank sales; he will continue to be located at eastern division headquarters in Lachine, Que.

K. B. Martin

Joy Manufacturing—D. W. M. Ross is now president of Joy Manufacturing Company (Canada) Limited, succeeding J. A. Drain, M.E.I.C., of Pittsburgh, Pa., who becomes chairman of the board of the Canadian Company.

Staff Promotions—The following promotions have been announced by the Ontario Water Resources Commission: D. S. Caverly, M.E.I.C., director of plant operations; G. M. Galimbert, director of sanitary engineering; L. Owers, JR.E.I.C., supervisor of sewage works, and K. H. Sharpe, supervisor of water works, both of the division of sanitary engineering; K. Symons, supervisor of surface waters, division of water resources.

Du Pont Plastics Division — The following appointments have been announced by the Du Pont Company of Canada (1956) Limited in connection with the formation of their plastics division: J. H. Childs, manager; J. L. Macdonald, sales manager, and F. G. Rice, market development engineer.

Canadian Westinghouse — It has been announced that Rear Admiral K. F. Adams, recently retired from the RCN, has been appointed manager, commercial development for Canadian Westinghouse Company Limited, Hamilton, Ont.

Universal Form Clamp Co. — G. W. Milligan has recently been named manager of the Universal Form Clamp Co. of Canada Ltd., located at 226 Norseman Street, Toronto.

PSC Appointment — W. A. Dymond has been made commercial manager of The Photographic Survey Corporation, Toronto.

New Branch Managers — Canadian Liquid Air Company Ltd. has announced the appointment of A. O. Raymore as manager of its Winnipeg branch, and J. A. Partridge as manager of the Edmonton branch.

D. W. M. Ross

CGE Appointment — The appointment has been announced by the Canadian General Electric Company Limited of R. J. Bridgman as sales manager, appliances, in the Toronto district office of the company's wholesale department.

F. J. Stokes Appointments — F. Y. Walters, Jr., has been appointed manager of the F. J. Stokes Company of Canada, Ltd., a subsidiary of F. J. Stokes Corporation, Philadelphia, and R. Wilson has been made a sales engineer. Headquarters of the Canadian Company are at 4198 Dundas Street West, Toronto.

Shell Oil Company — P. Gordon has been appointed by the Shell Oil Company of Canada, Limited as assistant manager of its Shellburn refinery, Vancouver; he replaces E. A. Ballman who has been named assistant superintendent of Shell's refinery at Martinez, California.

Canadian Vickers Appointment — R. R. Brooks has recently been appointed supervisor of boilers and thermal equipment sales, Canadian Vickers Limited.

Leland Electric — M. Lalonde, JR.E.I.C., B. MacRitchie and D. M. Campbell,

have been made sales engineers with Leland Electric Canada Limited. Mr. Lalonde joins the Montreal branch office and Messrs. MacRitchie and Campbell will operate in the Toronto and Southwestern Ontario areas respectively.

Norton District Representatives — The Norton Company of Canada Limited has announced the appointment of three district representatives as follows: S. Andersen, Toronto; I. H. Hall, Southwestern Ontario with headquarters in Windsor; and J. A. MacRae, Northwestern Ontario, with headquarters in Hamilton, Ontario.

Atlas Copco Expansion — Two branches of Atlas Copco Canada Ltd., Montreal Airport, Que., have moved into new and larger quarters to provide better service to customers, and more efficient operations because of expanding business. Construction of a new office, warehouse and service centre for the Toronto district branch has been completed and the branch is now located in New Toronto, Ont. This is the second move made necessary since 1951 to accommodate this growing branch. The Sudbury branch of Atlas Copco Canada Ltd., has recently opened its new office and warehouse building, which was designed by architect Cryst H. Sawchuck, of Sudbury and erected by Temiskaming Construction, of Haileybury.

News of Business and Industry

Change of Company Name — To avoid confusion and to increase their identity with the parent company, Kent-Norlantic Limited have changed their name to George Kent (Canada) Ltd., and have opened a new office at 2760 West Broadway, Vancouver 8.

Record Sales — Sales of $72,635,000 in 1957 established a new record, nine per cent over 1956, according to an announcement by Du Pont Company of Canada (1956) Limited in a preliminary review of the year's operations. Net income of $4,491,000 which is subject to audit, was equivalent to 60 cents a common share, seven cents less than the preceding year. Profits from the additional sales volume were more than offset in the second half of the year by the heavy expenses of the initial operation of new units in the diversification program. Expenditures on plant construction totalled $14,654,000 during 1957 as two large plants were completed and important expansions of existing plants were underway. Total costs were indicated to be higher than in 1956, due to increases in salary and wage rates, expenses incurred in the training of the operating and sales staffs for commercial explosives and "Orlon" acrylic fibre, and depreciation charges at relatively high rates on the new plants from the date operations commenced.

"Turnall" Pressure Pipe — Atlas Asbestos Co. Ltd. have announced that, effective May 1, 1958, "Century" asbestos-cement pressure pipe became "Turnall" asbestos-cement pressure pipe. "Turnall" pressure pipe will be manufactured to the same standards as the "Turnall" building materials and will conform to A.W.W.A. Specification C400-53T and A.S.T.M. Specifications.

New Location — Early this year, Simmonds Products of Canada Limited and their associate company, Simmonds Aerocessories of Canada Limited, conducted a transfer of their operations from Montreal to 637 Parkdale Avenue North in Hamilton, occupying the 10,000 sq. ft. building formerly operated by Grisenthwaite Construction Company.

Name Confusion — American Smelting and Refining Company have often been referred to as AS&R and, in order to avoid confusion, would like it known that their informal "name" is Asarco.

Diesel Engine Plant — A 289,000 square foot addition to the General Motors Detroit diesel engine division plant in Detroit is under construction and completion is expected next May. The new building will house all final assembly, testing, and shipping facilities for Detroit Diesel. Sales and service in Canada of engines manufactured at Detroit Diesel are handled by General Motors Diesel Limited, London, Ontario and their 45 distributor and dealer outlets, situated from coast-to-coast.

European Representation — Stadler Hurter International Ltd. announce that they will be represented in Continental Europe — with the exception of the Scandinavian countries — by the French consulting firm of Serete, 164 Rue de Rivoli, Paris. Under the new agreement Stadler Hurter will furnish process, layout and pulp and paper mill design know-how to European clients, and Serete will furnish civil and structural engineering, steam and power plant design and detailed mechanical design service for the pulp and paper industry, under the supervision of Stadler Hurter. Stadler Hurter have a similar agreement with Construcciones Industriales, S.A., Oaxaca 24, Mexico, D.F., who represent them in Mexico and Central America.

Wire Reinforcement Institute — Among new members added recently to the Wire Reinforcement Institute, trade association of welded wire fabric manufacturers, is the Steel Company of Canada, Limited. Stelco, as the Hamilton, Ontario, Company is known, is the first Canadian welded wire fabric manufacturer to join the Wire Reinforcement Institute. The Institute, which has its headquarters in Washington, D.C., founded in 1930, is a nonprofit organization for industry-wide research, education, promotion, and assistance to builders, architects, engineers, contractors, and the public.

Patent Disclosures — For the third consecutive year, engineers and scientists of the Canadian Westinghouse Company have established a new record for submitting patent disclosures. Canadian Westinghouse "Inventor Awards" program makes monetary payment for inventions to encourage engineers to put their thoughts on paper. Additional recognition is given company employees who create some particularly useful development.

Record Sales Reported — The Trane Company, manufacturing engineers of air conditioning, heating, ventilating and special heat transfer equipment, has reported record 1957 year-end figures showing total sales up 8.3 per cent and profit 8.8 per cent ahead of 1956. The company states that sales in Canada advanced by nine percent, consolidated sales increased from $74,444,000 in 1956 to $80,648,000 in 1957, and profit moved up to $6,244,000 for 1957, compared with $5,740,000 in 1956. During 1957, Trane sold 150,000 shares of common stock, providing $6,700,000 for financing expansion. The proceeds from this sale were added to the general funds of the company and are just now being used in the firm's continuing expansion program.

New Aluminum Processing Plant—Agreement has been reached to form a new company to manufacture aluminum wire and cable in Canada. The company, to be known as Phillips CBA Conductors Ltd., is a joint enterprise of Phillips Electrical Company Limited, wire and cable manufacturers, and Canadian British Aluminium Company Limited, who have a large refinery at Baie Comeau, Quebec. This is said to combine an assured source of raw materials with an established manufacturing and marketing organization. With location planned for Brockville, the new venture will have access to both railways, the Seaway, and the main highway to the major markets of Canada. When incorporated, Phillips CBA Conductors Ltd., will be managed by Phillips Electrical Co. under a management contract, and the Phillips organization will act as a marketing agency for the company's products. It is planned to manufacture aluminum rod, wire and cable, including ACSR for power transmission.

Agency for Electronic Lines — A. C. Wickman Limited, of Toronto, has announced that they have assumed the agency of Edin Company Inc., of Worcester, Massachusetts. This new line consists of oscillographs and amplifiers for industry and the medical profession.

Expansion of Equipment — Monsanto Oakville Limited, producer of commercial and industrial vinyls, has just announced the completion of a major expansion of modern processing equipment to meet the growing demand for high quality vinyl products, and the increased use by Canadian manufacturers. The new production facilities will be utilized to increase supplies of vinyl film and Monsanto's range of fabric-backed vinyls.

New Companies — Engelhard Industries, Inc., a U.S. industrial corporation, came into existence in January, 1958, as a result of a consolidation of nine U.S. companies.

Announced also was the simultaneous establishment of Engelhard Industries of Canada, Ltd., with headquarters in Toronto and a sales office in Montreal. This company will be a successor to Baker Platinum of Canada, Ltd., an affiliate of one of the companies involved in the merger.

New Address — Proctor and Redfern announce the new location of their offices at the Proctor and Redfern Building, 75 Eglinton Avenue East, Toronto 12, Ont. Tele. No. HU. 7-1171.

New Equipment and Developments

Electrorefining of Nickel — Research scientists and engineers of The International Nickel Company of Canada, Limited, have developed a new process for the electrorefining of nickel, according to a recent Inco announcement. The new method, developed after seven years of continuous study, is said to be a major achievement in chemical metallurgy. A main feature of the process is the direct electrolysis of nickel matte, an artificial sulphide. This contrasts with the usual electrorefining methods, including those employed in the nickel industry, in which a metal anode is used. The process, for which Canadian and United States patents are pending, is in commercial operation in a section of the company's Port Colborne, Ont., nickel refinery.

Evaporation Plant—A new design of evaporators for producing high-purity distilled water from sea water at a rate of hundreds of tons a day has been achieved by Richardsons, Westgarth and Company, Ltd., of Wallsend-on-Tyne, England. The whole evaporator may be arranged in a single vessel. This provides considerable saving in space and cost and dispenses with much external pipework. Operating methods have been developed so that deposits on the heat transfer surfaces are negligible, the firm states. In test runs it was shown that these deposits appeared only after prolonged running of the plant and even then were only in the form of a thin layer of powder considerably less than one thousandth of an inch (0.025 millimetre) thick.

Open Dropout Cutouts — Heavy duty cutouts with twice the interrupting capacity of the existing heavy duty units are now available from Canadian General Electric Company Limited. A new design of the fuse link holder enables the 7.8 kv. cutouts to be boosted from 5,000 to 10,000 amps., and the 15 kv. line from 4,000 to 8,000 amps. rated interrupting capacity at 60 cycles. The fuse holder, made of tough fiberglass reinforced polyester resin, has an expandable cap action. Under low fault current gases are expelled downward, and under high fault currents the gases are vented both down and up. The new fuse holders are interchangeable with previous models and can be used in many existing G-E open cutout frames.

Compact Tools — Two new, compact, portable tools, that quickly roll grooves into lightweight pipe and tubing, without removing any metal, have been developed by the Victaulic Company of Canada, Toronto. Designated "Vic-Easy" series 100 and series 200, these portable tools for use on-the-job or in-the-shop are adjustable from 1¼ in. through 12 in. diameters. The tools make it easy for anyone to groove pipe ends for leak-tight jointing of water, oil, air or other lines with Victaulic snap-joint standard or lightweight couplings, and Victaulic full-flow fittings.

Expansion Joint — B. F. Goodrich Canada Limited have announced the development of a new expansion joint designed to eliminate the rhythmic road shock which motorists often encounter on many Canadian highways. The joint section is made of man-made rubber specially compounded to absorb movement of the highway in cold or warm weather. This is important due to the variations in weather extremes encountered in Canadian seasons. Originally designed for super-highways, the new rubber expansion joint is also being designed for use on bridges and bridge approaches, as well as for highways and even airport runways.

Fluorescent Lamps — The introduction of a new line of fluorescent lamps with an increased light output has been announced by the Canadian Westinghouse Company Limited. Called the Super-Hi fluorescent lamp the new units use a mixed gas principle pioneered by Westinghouse which permits long cathode life and makes the high wattage practical in the conventional T12 bulb.

Polyethylene Film — A cheaper way has been evolved for protecting heavy equipment during rail shipment in gondola cars by using disposable covering of Visqueen polyethylene film, according to Visking Company, division of Union Carbide Canada Limited. No crane is needed and two men can handle the light covering, battening it in place with pattern strips of salvage wood. Visqueen film is said to be so inexpensive that even as a disposable covering it more than pays for itself because it eliminates having the canvas returned by the customer for credit. Visqueen film is produced by Visking Company, division of Union Carbide Canada Limited.

New Rock Drill — Atlas Copco Canada Ltd. has announced the introduction of a new rock drill for drilling holes up to 18 feet. The new machine, numbered BBD-50W and known as the Tiger, has many new features of importance to the mining and construction industry. Of particular significance is the fact that most of the parts on the Tiger are interchangeable with those of the BBD-46 stoper. This factor is of economic importance to operators since it reduces the requirements for spare parts in inventories.

Silicone Oil — Union Carbide L-45 silicone oil, electrical grade, is a clear dimethyl silicone polymer. It is said to possess all the advantages normally associated with silicone oil, such as excellent thermal and oxidative stability, high flash point, and small changes in viscosity with changes in temperature. The electrical grade liquids are specially dried, packaged, and control-tested to insure maximum dielectric strength and volume resistivity.

Delpark Filter Distributors — Joy Manufacturing Company (Canada) Limited becomes the exclusive distributor for the Delpark filter to the mining industry in Canada, and also has the exclusive franchise to sell the filter to any other industry when sold as a component part of the Joy Microdyne dust collector. The Delpark filter is manufactured by Industrial Filtration Company. It provides a dependable source of clear water for locations having only a dirty water supply. Dirt is removed in the form of a damp, clay-like slurry. At the special request of Joy, the Delpark unit was modified specifically for mine use and the handling of low-gravity solids.

Publications

Asbestos—On the occasion of its 100th anniversary, Canadian Johns-Manville Co. Limited has published a 32-page illustrated booklet entitled "Asbestos, the Magic Mineral'.

Wood Tank Data Book—An up-to-date reference source on wood tanks, the "Wood Tank Reference and Data Handbook", has been published by the National Wood Tank Institute, Chicago. The volume includes such subjects as: the uses of wood tanks; capacities; physical and chemical properties of wood and their relation to expected service of wood tanks, etc. This manual projects the use of wood to cover the most severe conditions found in chemical processing by the use of selected polymer linings.

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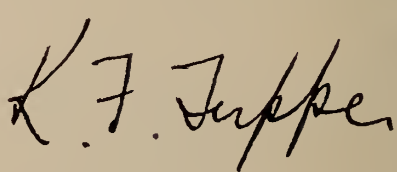
Message from the President

THE ADVENT of earth satellites, electronic computers, nuclear power plants and nuclear weapons has focussed the public's attention on the works of the scientist and the engineer. There has been a clamour for the training of more scientists and engineers.

If engineering is to become and continue a profession I think we engineers must be willing to take a larger share of responsibility for the social consequences of our work. It seems there is a real danger that instead of becoming leading citizens as they well might be, engineers may tend to become technological mercenaries. I fear that too often the men who have the training and talent to design and develop an unlimited variety of new devices can be hired by any employer who offers attractive working conditions, good pay, and a task with a technical challenge; that these men do not regard it as any of their business to enquire into the impact of their work on the society in which they live. "A technologist is a man who knows everything there is to know about his job except its place in the scheme of things".

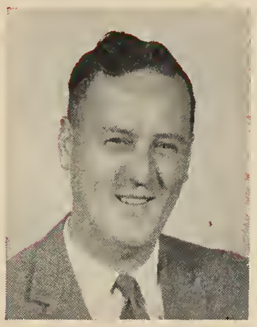
Of course we cannot all enter political life. Our society has a place for many honest men, those who bake bread and cut hair as well as those who design or build bridges. But we can take an interest in public affairs particularly those which relate to our work, the use of expendable resources in particular.

During the next twelve months I hope I shall be able to visit most of our fifty branches, and meet a great many of the Institute members. I am deeply appreciative of the privilege which you have conferred upon me in letting me serve you as your President. I undertake to bring to this task all the energy I can muster and all the wisdom I may possess.



K. F. TUPPER, M.E.I.C.
President

MEET THE AUTHORS



J. F. Whiting, Aluminium Laboratories Limited, Kingston, Ont. *(The Corrosion Behaviour of Aluminum in the Construction Industry.)* Mr. Whiting graduated from Queen's University, Kingston, Ont. in 1941 (B.Sc., metallurgical engineering). From 1941 to 1948 he was a member of the technical staff of the Aluminum Company of Canada, Limited, Kingston Works, and in 1948 was transfered to the Publications Division of Aluminium Laboratories Limited, Kingston. He is a past president of the Eastern Ontario Chapter of the Society of Technical Writers and Editors, and a member of the National Warm Air Heating and Air Conditioning Association of Canada.

H. P. Godard, Aluminium Laboratories Limited, Kingston, Ont. *(The Corrosion Behaviour of Aluminum in the Construction Industry.)* Dr. Godard holds a master's degree in chemical engineering from the University of British Columbia, and a Ph.D. in industrial and cellulose chemistry from McGill University. An industrial chemist, he worked in B.C., Ontario and Quebec before joining Aluminium Laboratories Limited in 1945. He is a member of the N.R.C. Associate Committee on Corrosion Research and Prevention, has served on the Board of Directors of the Chemical Institute of Canada and is vice-president elect of the National Association of Corrosion Engineers.

J. C. Langford, Production Manager, Canadian Chemical Company Limited, Edmonton, Alta. *(Design and Operation of an Effluent Disposal System.)* A graduate of the University of Toronto (B.A.Sc. chemical engineering, 1938), Mr. Langford obtained an M.Sc., chemical engineering, from the University of Michigan in 1939. From 1939 until 1946 he was associated with C-I-L and Defence Industries Limited in the Province of Quebec; he spent a year in Montreal as a consulting engineer before joining the Dominion Tar and Chemical Co. Ltd., development department, in 1947 where he held several senior positions. He joined his present company in 1955.

J. P. Hague, Senior Location Engineer, Department of Highways, Province of British Columbia. *(Selection of the Trans-Canada Highway Route Through the Selkirk Mountains.)* Mr. Hague has been associated with the engineering industry since 1923; he was resident engineer on railway construction with the Canadian Pacific Railway Company for eight years, and spent seven years with the Manitoba Department of Public Works where he was resident engineer on highway construction. He is a member of the Association of Professional Engineers, and served in the Royal Canadian Engineers from 1940 to 1947, lieutenant to major. Mr. Hague joined the B.C. Department of Highways in 1947, and is now in charge of highway location and design.

W. H. Hoyle, Radio and Electrical Engineering Division, National Research Council, Ottawa, Ont. *(Marginal Punched Cards for a Reference File in the Field of Electronics.)* An electrical engineering graduate of the University of Alberta (B.Sc.) and McGill University (M.Eng.), Mr. Hoyle served in the Royal Canadian Navy during World War II. On demobilization he joined the National Research Council and worked on transmission line fault location, but was transferred to military work on the outbreak of the Korean War; he is now engaged mostly on military work. Mr. Hoyle takes a deep interest in the work of the Canadian Standards Association, particularly in their electrical safety codes; he is a member of the A.I.E.E.

C. Jaeger, Consulting Engineer, The English Electric Company Limited, England. *(Economics of Pumped Storage.)* Dr. Jaeger graduated from the Federal Institute of Technology, Zurich, Switzerland, in 1923, and subsequently became senior lecturer in civil engineering there; simultaneously, he was engaged on scientific research at the Federal Hydraulic Research Station, Zurich. He became a lecturer on engineering fluid mechanics at the Federal Institute of Technology, Zurich, in 1943, and since 1946 has been consultant to The English Electric Company Limited, and also special lecturer in hydro power at the Imperial College, London, England. Dr. Jaeger is the author of numerous publications on engineering fluid mechanics, arch dams, underground power stations, and economics of power production.

COVER PICTURE

The 72nd Annual General Meeting of The Engineering Institute of Canada is reported on pages 85 to 87. The cover picture shows (l. to r.) C. M. Anson, M.E.I.C., the retiring President of the Institute; L. Austin Wright, Hon. M.E.I.C., whose retirement as General Secretary was announced at the meeting; and K. F. Tupper, M.E.I.C., the newly-elected President of the Institute.

Photograph: Canadian Pacific Railway

The Corrosion Behaviour of Aluminum in the Construction Industry

J. F. Whiting and H. P. Godard
Aluminium Laboratories Limited, Kingston, Ontario

Paper received 11 April 1957. Originally read at a meeting of the National Association of Corrosion Engineers, Detroit, Mich., 1956.

The general corrosion behaviour of aluminum alloys used in the construction industry and the influence of environmental factors on their performance are discussed. It is shown that aluminum is a preferred metal for many applications, is suitable for most applications, and is unsuitable for a few applications. With good design, correct choice of alloys, and normal care during installation, aluminum will give excellent service for a wide range of applications in the construction industry.

ALUMINUM AND its alloys have good corrosion resistance and are suitable for most architectural and structural uses in the construction industry. This is borne out by the fact that about one-third of all aluminum fabricated forms produced in Canada and the United States are used in building and the tonnage is increasing rapidly. Industrial and agricultural roofing and siding are well established as one of the main uses of aluminum. Aluminum curtain-walls, windows, store fronts, doors, railings, trim and hardware are also very important uses of this light metal. Additional large quantities of aluminum are used for finned radiators, radiant heating and cooling panels, ductwork, flashings and general sheet metal work. Bus bar, electrical conduit, scaffolding and ladders are other items fabricated in aluminum.

Aluminum has many desirable properties, one or more of which may warrant its use over competitive construction materials. These important properties are:

Good durability; colourless corrosion products; light weight; pleasing appearance; ease of fabrication, transportation, and erection; good electrical conductivity; good heat-reflecting qualities; availability in many forms—plate, sheet, extrusions, tubing, wire, bus bar, foil, castings and forgings; and reasonable cost.

While all the above properties are important and much could be said about them, this paper will deal mainly with the corrosion resistance of aluminum in the construction industry.

Definitions

Corrosion is defined as the destruction of a metal by reaction with its environment. To the layman corrosion is simply the deterioration of the metal, but to the specialist it may occur in several forms or types. These types are defined briefly here to avoid confusion when they are mentioned later in the text.

General Corrosion — General corrosion is uniform attack that leads to the gradual thinning of a piece of metal with time. This is the type of corrosion met with most frequently in the construction industry and, in the case of steel, due allowance is made for it in design. No such allowance is usually necessary for aluminum.

Galvanic Corrosion — Galvanic corrosion is that type of action produced when one metal is in contact with another in the presence of an electrolyte. Galvanic action usually results in the accelerated corrosion of one metal of the pair and the protection of the other. An example of a galvanic couple is the zinc-steel combination of galvanized steel. The zinc coating is placed there deliberately to protect the steel from rusting.

Crevice Corrosion — Crevice corrosion is encountered most commonly when water is trapped in the crevice between the faying surfaces of a joint. Pitting develops just inside the crevice where the metal is in contact with water depleted of oxygen. An anodic condition exists here relative to the mouth of the crevice where the water is saturated with oxygen.

Poultice Action — Poultice action of wet absorbent materials such as paper, cardboard, cork, felt, asbestos, etc., over prolonged periods may lead to corrosion by the oxygen concentration cell mechanism. Poultice action is simply a special type of crevice corrosion. It may be aggravated by corrosive agents leached from the absorbent materials.

Pitting Corrosion — Pitting corrosion occurs on a film-protected metal when the film is almost, but not completely, protective. It may cause perforation of a roof or pipe although only a very small amount of a metal is corroded.

Deposition Corrosion — Deposition corrosion is a special case of galvanic corrosion and results from the deposition of particles of a more noble metal on the surface of another metal. This may be caused by settling or be the result of electrochemical action. The particles set up local cells and lead to pitting of the metal surface.

Intergranular Corrosion — Intergranular corrosion is a form of localized sub-surface attack in which a preferential path of small dimensions is corroded out along the grain boundaries of the metal. This type of corrosion is seldom encountered in the construction industry.

Corrosion Rate Curves and Their Importance

There is no uniform criterion or "yardstick" to measure corrosion resistance, because the seriousness of a given amount of corrosion depends on the use to which a metal is put. A corrosion rate that can be tolerated in one application may be completely unacceptable for another. The most common criteria for the evaluation of corrosion resistance are:

1. Time to perforation
2. Loss of strength
3. Impairment of appearance
4. Contamination of a product

For roofing, flashings and hot water tanks, resistance to perforation is most important. On the other hand a structural member can perforate without serious loss of strength and, in this case, resistance to mechanical failure is most important. With metal curtain-walls, windows, store fronts and other architectural items, resistance to impairment of appearance is the important and desirable property. Contamination of a product by metal pickup is not usually a problem in the construction industry although it is often critical in chemical and food processing equipment.

It is important to choose the right criterion for evaluating corrosion. If the criterion is made too restrictive, a metal that is suitable may be excluded. The layman accepts the fact that steel rusts and that copper roofs turn green and rarely gives the matter a second thought. However, he is apt to view with alarm the natural greying which accompanies the weathering of aluminum, even though it is of no practical significance to durability.

The rate of corrosion of a metal is rarely constant and may take one of the three general forms shown in Fig. 4. Of the three types the decreasing rate curve is the most common and is typical for metals exposed to the atmosphere.

Figure 5 shows the corrosion rate curves for three aluminum alloys at several atmospheric exposure stations,[1] From Fig. 5 it can be seen that if the first initial rate of attack can be tolerated, the long term rate is usually low enough to be acceptable for most purposes. Also, it can be seen that by doubling the thickness of the material, its life will be extended much more than twice.

The surface to volume ratio of a metal object will have a marked influence on its corrosion life. If the ratio is high the part will deteriorate more rapidly than if the ratio is low. For example, the rate of deterioration of fine wires increases as the diameter of the wire is reduced; this is because the loss of a given thickness of metal is a larger percentage of the original for thin than for thick wires. A 1-inch diameter aluminum lightning rod on the mouth of an industrial smoke stack lost 12 per cent of its cross section due to corrosion in 28 years, yet remained an effective air terminal. On the other hand the stranded aluminum grounding cable (wires 0.140 inch diameter) corroded away completely at the mouth of the stack. An aluminum insect screen (wire diameter 0.012 inch) on a seashore cottage may deteriorate in a period that would not measurably affect an aluminum roof on the same cottage.

The heat capacity of a metal part can affect the corrosion rate. This may be due to the thickness of the metal itself or to the heat capacity of other objects to which the metal is affixed. This effect has been demonstrated by exposing two panels of aluminum sheet in a horizontal position in the atmosphere, one with a large block of aluminum on top, and one exposed by itself. After about a year, pitting was more severe on the under surface of the sheet beneath the block than on the single sheet even though the surfaces were side by side. The mass effect of the large block of aluminum prevented the panel beneath it from coming up to atmospheric temperature as quickly as the panel exposed by itself and thus, moisture condensed on its under surface remained there for a longer period of time. It has been demonstrated also that thick metal specimens corrode in the atmosphere at a slightly higher rate than thin ones.

Function of the Oxide Film on Aluminum

Aluminum has excellent resistance to weathering and chemical attack owing to a thin oxide film which covers it at all times. This film forms naturally and instantaneously whenever aluminum is exposed to the air and it slowly increases in thickness as the exposure time increases. If corrosion occurs it is the result of circumstances which damage the oxide film and prevent it from reforming. The ability of the oxide film to protect the aluminum depends greatly on the environment and conditions of service. Therefore, a knowledge

Fig. 1. The Laurentien Hotel, Montreal, Que., erected in 1946/47, was the first multi-story building on this continent to be faced with aluminum.

of the behaviour of aluminum in natural environments and in contact with the common construction materials is necessary to promote proper design and methods of installation.

Behaviour of Aluminum in Natural Environments

Atmosphere

In rural atmospheres the corrosion of aluminum is barely detectable (less than 0.003 mpy). In industrial and marine atmospheres aluminum tends to corrode somewhat more rapidly; the rate stays between 1-4 mpy for the first six months to two years, depending on locality and alloy, and then slows markedly to rates in the order of 0.1 mpy. The Church of St. James in Rome was covered with aluminum in 1897 and an inspection in 1949 showed the roof to be in excellent condition with a corrosion rate of approximately 0.06 mpy. The corrosion rate on a fifty-two year old aluminum cornice on a building in down-town Montreal which has a heavy industrial atmosphere, was 0.12 mpy. A recent publication by the ASTM[2] gives the average corrosion rate and maximum depth of attack for several aluminum alloys exposed at various locations in the United States (see Table I).

Fig. 2. Aluminum curtain-wall construction used on the Commonwealth Building, Ottawa, Ont. (Built in 1955.)

Behaviour of Alloys — Aluminum of very high or super purity (99.99% minimum aluminum) has exceptionally good corrosion resistance and is used for special purposes. Commercially pure aluminum varies in purity from Alcan 1S (99.5% minimum aluminum) to 99.8% and, in general, the higher the purity the better the corrosion resistance. However, for most uses there is little difference in performance and they may all be rated as excellent. Alcan 2S (US 1100) and 3S (US 3003) have very good corrosion resistance although Alcan 3S alloy is somewhat superior to Alcan 2S in resistance to pitting and has higher strength. The aluminum-magnesium alloys, such as Alcan 57S (US 5052) B54S (US 5154) and A56S (US 5056), have excellent resistance to attack by marine environments and in other environments are in a class with Alcan 1S. If the application involves prolonged exposure to temperature above 60°C. (140°F.), the corrosion resistance of alloys containing more than 2.5% magnesium may be adversely affected and the aluminum supplier should be consulted. Alcan 50S (US 6063) has good resistance to weathering and chemical attack and is rated with Alcan 3S. Alcan 65S (US 6061) is a general-purpose, medium-strength alloy that weathers well and has good corrosion resistance, although its surface appearance may deteriorate more rapidly than Alcan 50S in some severe industrial environments. Alcan 17S (US 2017), 24S (US 2024), 26S (US 2014) and 75S (US 7075) alloys have somewhat lower corrosion resistance and are not used in a corrosive environment without a protective coating such as Alclad or paint or both. Following World War II several aluminum producers in various parts of the world marketed a general purpose corrugated roofing sheet made from scrap aircraft alloys. The composition of this sheet varied widely but usually it contained several per cent copper. It was clad with pure aluminum to give improved corrosion resistance but owing to improper fabrication and heat treatment the copper diffused into the cladding, and early failure was frequent in marine and industrial environments. Failure was by intergranular corrosion with exfoliation at the edges of the holes. It is unfortunate that this material was used since aluminum has unjustifiably been given a bad name in the countries where trouble occurred.

TABLE I—Corrosion of Aluminum Alloys Exposed About 20 Years to Different Atmospheres

Location	Type of Atmosphere	*2S alloy (1100—H14)* Av. penetration based on loss of weight mpy.	Max. measured depths of attack mils	*3S alloy (3003—H14)* Av. penetration based on loss of weight mpy.	Max. measured depths of attack mils
Phoenix, Ariz.	Rural	0.003	0.7	0.0005	0.4
State College, Pa.	Rural	0.003	3.5	0.003	2.2
New York, N.Y.	Industrial	0.029	8.4	0.037	6.4
Altoona, Pa.	Industrial		11.0		7.5
Key West, Fla.	Marine		4.9		4.6
Sandy Hook, N.I.	Marine	0.011	9.1	0.014	3.3
LaJolla, Calif.	Severe Marine	0.025	14.0	0.026	10.2

Corrosion of casting alloys is usually less of a problem than with wrought alloys since, in general, the cross section is thicker, and more surface corrosion can be tolerated. The aluminum-magnesium alloys, such as Alcan A320 (US 214), 340 (US best corrosion resistance particularly in marine environments. The aluminum-silicon alloys, such as Alcan 123 (US 43), 135 (US 356) and 160 (US 13), have very good resistance to weathering and chemical attack and are used widel yin aggressive locations. The aluminum-copper alloys, such as Alcan 125 (US 355), 225 (US 195) and 250 (US 122) have somewhat lower corrosion resistance than the above alloys and are not used in corrosive locations without protection.

The aluminum alloys used most widely in the construction industry are Alcan 3S, 50S and 65S for wrought products and Alcan 123, 135, and A320 for cast products. From the discussion above it can be seen that all these alloys have excellent resistance to weathering even in severe environments.

Water

Water, containing air or oxygen, is responsible for most of the corrosion of metals in service. If the air or oxygen are removed corrosion will cease. On the other hand, water may decrease the corrosion rate. For example, it is well known that aluminum exposed to an aggressive atmosphere corrodes more slowly if rained on frequently, because the water dissolves and washes away corrosive residues such as soot or salts.

Pure rain water is not corrosive toward aluminum but it may become so if contaminated with traces of impurities such as soot, alkalis, acids, and salts of copper and iron. Water running off a copper roof on to aluminum may deposit copper salts on the aluminum which may eventually lead to pitting. Water contaminated by extracts from mortar and concrete may stain aluminum and under severe conditions corrode it, though at a slow rate.

Only limited information is available on the corrosion of aluminum in natural waters. Papers by Sawyer and Brown, ([3]) as well as Porter and Hadden, ([4]) contain valuable information on this subject. If corrosion does occur it is in the form of pitting.

In 1948, a 50,000 gallon elevated water storage tank was erected at the Shawinigan Falls Works of the Aluminum Company of Canada, Limited. It is an all welded tank made from 3S (US 3003) plate: the floor plates are ½ inch thick, wall

Fig. 3. Extruded aluminum rail at the new Woodbine race track, Toronto, Ont. Installed in 1956.

plates ¼ inch thick and the roof plates 3/16 inch thick. Inspection in the fall of 1956 revealed that pitting of the wall and floor plates had occurred to an average depth of 1/32 inch and a maximum depth of 1/16 inch. This pitting represents about 20 per cent of the thickness of the wall plates and should not affect appreciably the service life of the tank. The water stored in this tank has an approximate total solids contents of 47 ppm and the pH of 5.5 to 7.0

Another use of aluminum for handling waters that has been very successful is portable-pipe irrigation systems. Despite the very thin wall (about 0.050 inch), few pitting troubles have been reported. This is attributed to two facts: (1) when full, the water is moving; and (2) during moving of the system, the interior wall dries.

Still another use of aluminum that promises to be successful is for domestic hot water tanks. In very aggressive waters corrosion may be encountered, but these locations are also corrosive to other metals. In this case, the reduction in pitting rate with temperature is probably a factor; experience indicates that the best performance is obtained when water is hot (in the range 150-190°F.)

It is not possible, as yet, to predict the behaviour of aluminum with certainty from a conventional table of water composition; a field trial must be made (which can be completed within a year). However, some general conclusions can be drawn from experience thus far. Very soft waters, such as those at Arvida, Quebec (total solids 45 ppm and pH 8.4) and Ottawa, Ontario (total solids 75 ppm and pH 7.6), are least likely to corrode aluminum and its use for water piping in these locations is feasible. A recent inspection of aluminum piping in some government financed houses in Ottawa after nine years showed them to be completely free of corrosion. Fairly hard water such as that at Kingston, Ontario (total solids 185 ppm and pH 7.5) and hard water such as that at London, Ontario (total solids 335 ppm and pH 7.9) tend to pit aluminum, and its use for water piping in these locations would not be feasible. Traces of copper will cause pitting in either hard or soft waters. In general, high-solids soft alkaline well waters, such as are found in Central Alberta, tend to be corrosive to aluminum.

Usually movement of a corrosive liquid accelerates the rate of corrosion. However, when aluminum pits in an aggressive water, movement will slow down the amount and rate of pitting and may even prevent it entirely. At very high velocities (about 20 fps), which may cause turbulence at bends or fittings, localized corrosion of aluminum may develop. The presence of solids in the moving liquid may accelerate corrosion by eroding away the protective oxide film. Stagnant pools of water should be avoided by proper design.

Seawater and Marine Atmospheres

Aluminum is being used on an ever increasing scale for ship-building and for buildings in coastal areas where experience has shown it to have good durability in comparison with other metals. Case histories ([5]) of aluminum windows installed in coastal areas prior to 1940 prove that aluminum has good resistance to corrosion in this aggressive environment. A corrosion rate of about 0.4 mpy or one-tenth the rate for steel was found for Alcan 57S (US 5052) immersed in the ocean at Harbour Island, North Carolina. A few years ago, the author's company exposed foot square plates of quarter-inch thick mild steel and aluminum alloy (Alcan 65S-T6: US 6061-T6) on a rack facing the open Pacific Ocean near Port Alberni, B.C., which is about half way up Vancouver Island. Two years later the plates were examined after the removal of corrosion products and it was found that the steel plate had lost 940 grams (about 20 per cent of its thickness) while the aluminum plate had lost only 1 gram. Allowing for the difference in density the penetration ratio was about 300 to 1.

Soils

Little has been published on the corrosion behaviour of aluminum in various soils, but test programs are now underway which should provide considerably more information in the next few years. In general, the corrosiveness of soils to aluminum varies greatly from one type to another with moisture content being an important factor; poorly drained wet soils are generally more corrosive. If corrosion does occur it usually takes the form of pitting or etched patches with small weight loss, so that the rate of penetration is the most important criterion.

In the US Bureau of Standards soil corrosion program, (6) specimens of 2S, 3S, and Al-4.1 per cent Cu alloy were buried in five soils which are listed in decreasing order of corrosivity:

	pH
muck	4.2
sandy loam	9.5
Susquehanna clay	4.7
alkaline soil	7.4
tidal marsh	3.1

After ten years the Al-Cu alloy had completely disintegrated in the first two soils and had perforated in the other three. The other two alloys had pitted severely in all but the tidal marsh, where corrosion was slight (maximum penetration 13 mils).

In an English test program,[7] commercially pure aluminum sheet and tubing were buried for five years in five soils which are listed in order of corrosivity:

(1) Cinders. (2) Salt marsh. (3) Keuper marl. (4) London clay. (5) Moist neutral clay. These soils were all slightly alkaline in the pH range 7-8 and produced severe pitting except for the neutral clay in which aluminum was virtually unaffected.

Several short buried aluminum pipe lines carrying oil and gas are now in service in the United States with uncoated test sections. One test shows that a Louisiana salt marsh is relatively non-corrosive to aluminum. (8)

In a small test program we have found Al-Mg alloys such as 57S (US 5052) to be the most resistant to soil corrosion in several locations.

Underground in Mines

Aluminum equipment is used extensively in mining for such purposes as skips, cages, hopper cars, pit props, and tools. Performance varies with the nature of the ore body which influences the composition of the mine water. Aluminum is giving good service in the gold mines of Northern Ontario since 1931, (9) and in South Africa. It has been used extensively in English, German and Canadian coal mines as well as Canadian asbestos mines.

Behaviour of Aluminum in Contact with Building Materials

Wood Sheathing and Building Board

Frequently, aluminum roofs and flashings are laid over wood. The lumber should be of good quality, and well-seasoned. Green lumber should not be used. To prevent mechanical damage to aluminum, the wood sheathing should be laid carefully and firmly attached with all nail heads driven home.

Kiln-dried lumber, impregnated against decay, makes ideal sheathing where the cost is justified. It is recommended for cant strips, coping blocks, and facia boards to be covered with aluminum. Creosote and pentachlorophenol preservatives are satisfactory as they are non-corrosive to aluminum. Other preservatives may be used but assurance should be obtained from the manufacturer that they are not harmful to aluminum. Aluminum paint is an excellent primer for wood as it reduces the tendency for moisture absorption and eventual rot.

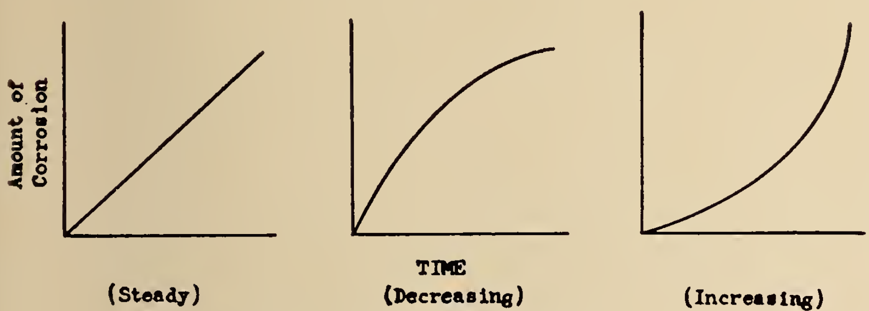
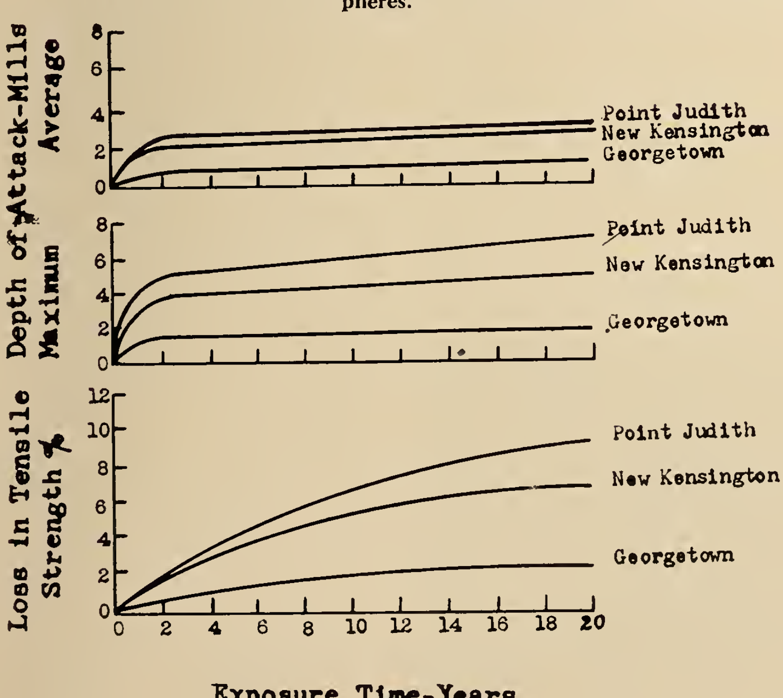


Fig. 4. Typical corrosion rate curves.

Fig. 5. Average rate of weathering of wrought aluminum alloys in various atmospheres.



All wood surfaces to be covered with aluminum should first be covered with an underlay of asphalt-saturated and coated building paper or felt. If the wood has been impregnated or painted, a satisfactory alternative is to back-paint the aluminum with bituminous paint.

Building board also provides a good surface upon which to place aluminum. In dry locations where condensation is not likely to occur, any type of building board should be satisfactory. Under moist conditions or where condensation may occur asphalt-impregnated building board is recommended. When impregnated building board is used, the aluminum should be back-painted before installation. When other types of building board are used under moist conditions, they should be covered with an underlay of asphalt-saturated and coated building paper or felt, before the aluminum is applied.

Fig. 6. Aluminum roof on the church of St. James, Rome, Italy, installed in 1897.

Fig. 7. Aluminum cornice installed in 1896 on the Canada Life building, Montreal, Que.

Concrete, Masonry, and Other Alkaline Building Materials

Concrete and mortar materials, such as Portland cement and lime, are alkaline and under some conditions may affect aluminum in contact with them. Experiments ([10]) and experience indicate that the action of concrete and mortar on aluminum is not rapid and if the concrete or mortar dries and stays dry the action comes to an end quickly without damage to the aluminum other than some mild etching. However, under wet or intermittently wet and dry conditions the rate of attack is higher and the aluminum should be protected by an underlay of asphalt-saturated and coated building paper or felt or by back-painting it with bituminous paint. The bituminous paint should be of the cut-back type.

Where aluminum is to be caulked into slots or reglets in masonry, brickwork or concrete, the slot or reglet should be cleaned out thoroughly and filled with caulking compound and not mortar or plaster. In effect, the aluminum should be "floated" in the caulking compound.

A few years ago a hospital was erected in which aluminum conduit ([11]) was embedded in reinforced concrete floors. The concrete was poured in the winter time and contained a fairly high percentage of calcium chloride. A few years later it was found that some of the aluminum conduit was badly corroded. An extensive laboratory investigation showed that aluminum embedded in concrete will be corroded by galvanic action only if three conditions are all met.

(1) Reinforcing steel must be present.

(2) There must be electrical contact between the aluminum and steel

(3) Calcium chloride must be present.

In the laboratory tests it was possible to duplicate exactly the type of corrosion found in the hospital. In the absence of calcium chloride in the concrete there is nothing to fear from aluminum-steel couples.

Pure gypsum plaster has little or no effect on aluminum. Stone, brick, stucco, terra cotta, etc., are often encountered in flashing work and these should be treated in a similar manner to concrete.

Several months ago we were asked to investigate a corroded aluminum coping on a large office building in Hamilton, Ontario. Numerous holes had appeared in the aluminum after about two years' service. These are illustrated in Fig. 11. Upon investigation it was found that the aluminum flashing had been installed in direct contact with the structural clay tile of the parapet wall. Figure 12 shows the inside surface of a flashing sheet and it can be seen that corrosion occurred mainly where the aluminum was in contact with the ribs of the clay tile or the mortar joint. It is well known that moisture in a crevice between mating aluminum surfaces or between aluminum and other building materials can cause corrosion of aluminum. The alkaline materials leached from the mortar may have contributed somewhat to the corrosion but were not the main cause of trouble. Back-painting of the aluminum sheet or the covering of the parapet with asphalt-saturated and coated building paper would have prevented the trouble. It was interesting to note that where the aluminum sheet was in contact with the wooden cap on top of the coping, no trouble was encountered.

Where aluminum in its "natural finish" is to be installed adjacent to concrete, masonry, or plaster work, as in the case of ornamental sheet-metal work, windows, spandrels, mullions, panelling, ducts, etc., it is wise to prevent stains resulting from careless splashes of mortar or plaster by giving the aluminum a thin coat of alkali-resistant lacquer. The methacrylate type is made by several paint firms and gives good results. If the film is sufficiently thin (i.e. 1 part lacquer to 3 parts thinner) it will gradually wear away without disfigurement. There are also several "peel off" types of coatings available, but care should be taken not to leave these on too long, since they sometimes become hard and difficult to remove.

Steel, Copper, and Other Metals

Aluminum may be used in contact with steel, copper, and other metals but with some combinations and under some conditions, galvanic corrosion may occur. An understanding of galvanic corrosion and its prevention is desirable and relatively simple.

Galvanic action cannot occur in the absence of moisture. In the presence of moisture galvanic action will only occur if the water solution will conduct an electric current; the better the conductivity of the electrolyte the stronger will be the galvanic action. Distilled water and pure rain water will not conduct electricity but when contaminated by smoke, soot or dust, they become electrolytes through the formation of weak acids. Also salty water is a very good electrolyte.

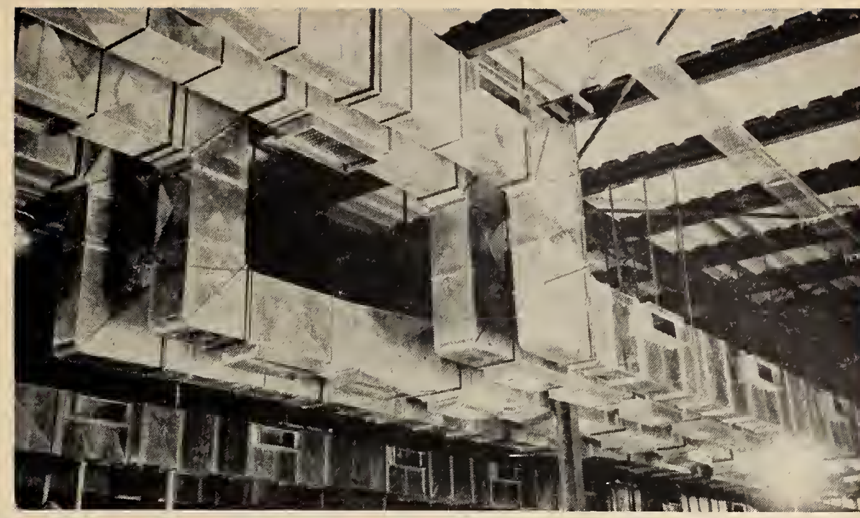


Fig. 8. Aluminum ductwork installed during 1954 in the Terylene plant of Canadian Industries Limited, Millhaven, Ont.

In most cases, the two metals are in direct contact but galvanic action may also occur when they are separated provided they are joined by a connection through which an electric current will flow. One of the simplest ways to stop the flow of current is to separate the two metals from one another by insulating gaskets of fibre, waterproof papers, rubber, bituminous paint, or plastic coatings. Care should be taken to avoid moisture absorbent papers or membranes.

Experience has indicated that the following holds true. Indoors, under dry conditions, any combination of metals may be used. Outside or inside, where moisture or condensation is present, the action between aluminum and iron or steel is extremely slow and can be eliminated readily by painting the iron or steel. Lead washers are satisfactory on aluminum nails used to secure aluminum roofing and siding, except in marine locations. Zinc, galvanized steel and stainless steel may be used in contact with aluminum under most conditions. However, in marine locations the zinc coating on galvanized steel soon disappears and an iron-aluminum couple is left. Direct contact with copper, brass, or monel should be avoided except under dry conditions, or if the thickness of the aluminum section is sufficient to tolerate some corrosion. In roofing and flashing work, in particular, copper should not be used above aluminum, even though the two may be separated by a considerable distance, since water running down over the copper will carry copper salts on to the aluminum and deposit them there, and this will lead to pitting of the aluminum. Aluminum may be used above copper provided that direct contact between them is prevented by an insulating gasket.

Insulating Materials

The insulating materials in general use today are composed of relatively inert substances which have no harmful effect on aluminum. However, high-soda glass wool and magnesia insulation may cause corrosion of aluminum by poultice action. This only occurs if these absorbent materials are wet and in prolonged contact with the aluminum. Coating of the aluminum with bituminous paint is an effective preventative against this type of attack. The suppliers of insulating materials should be asked whether or not their materials are satisfactory for use in contact with aluminum. Wood shavings and sawdust are used occasionally as insulating materials and for this purpose are usually treated to render them fire and vermin resistant. The effect of these substances on aluminum should be checked with the manufacturer before they are used.

Aluminum foil is increasing in popularity as an insulating material, and it may be used safely in contact with aluminum employed for other purposes. Aluminum foil is an excellent vapour barrier and it is frequently used for this purpose with other insulating materials.

Joint-Caulking Materials

Joint-caulking materials are widely used today to ensure the weather tightness of building components and assemblies. They must seal the joints effectively against moisture and yet retain sufficient plasticity to allow for slight movements.

Fig. 9. Welded aluminum water storage tank (50,000 gallons) erected in 1948 at Shawinigan Falls, Que.

A large number of caulking materials and compounds are available, some of which have been developed specifically for use on aluminum. The caulking compounds generally used with other metals, may in some cases be used with aluminum. Caulking compounds should be non-drying and those that show the least variation in plasticity with variations in temperature are preferred. Caulking compounds embodying zinc or barium chromate are effective for sealing joints in aluminum because both these chemicals inhibit corrosion of aluminum. To assist in the selection of the proper caulking compounds, some of the more common types of caulking materials and compounds are discussed below.

Fig. 10. Aluminum corrugated roofing and siding installed in 1952 on loading tower and conveyor at Kassa Island, French Guinea.

Mastic Compounds — Mastic compounds, as a rule, are very suitable for caulking joints in aluminum. Various compounds, using an asphalt, resin, or oil base, have been especially developed for use on aluminum. Aluminum pigment and zinc chromate are usually added to give additional protection and colour. Mastic compounds are usually fibred with asbestos and filled with marble dust or other similar materials. They are available in several consistencies to suit the various methods of application.

Thiokol-rubber type caulking compounds, which have many desirable properties, are being used widely by the aircraft and building industry. Available evidence indicates that this type of caulking compound is compatible with aluminum.

Zinc White in Oil — Zinc white (zinc oxide) in oil (usually fish oil) is a simple and effective caulking compound suitable for many types of joints. The oil base should be non-drying and its fluidity should suit the temperature range to which the work will be subjected. A typical mix consists approximately of two to three parts zinc oxide and one part oil.

White Lead — Caulking compounds consisting of white lead in oil have been widely used for many years on wood and metal, but are not recommended for aluminum.

Lead Wool — Lead wool should not be used to caulk joints in aluminum.

Atmospheric Performance of Anodized, Coloured and Porcelain Enamelled Aluminum

Anodized aluminum exposed in a rural atmosphere will maintain its pleasing initial appearance for an indefinite period of time. In severe urban and industrial atmospheres the coating will become covered with dust and soot particles and if regular maintenance is not carried out, pitting will occur. The simplest explanation is that moisture condenses on the particles and sulphur oxide gases are absorbed from the atmosphere to form sulphur acids. Thus, over a period of time, pitting of the anodic coating may take place at or under the particles of dust or soot. The length of time before pitting commences depends on the severity of the environment and the thickness of the anodic film. The pitting which occurs will not be serious from a structural point of view, but it will mar the appearance of the surface. Corrosive attack is less in a boldly exposed than in a sheltered location owing to the washing action of the rain. Thick anodic films (in the order of 1 mil) are more resistant to pitting than are thin films.

The necessity for periodic cleaning of anodized aluminum curtain walls, store fronts, doors, windows, and other architectural items, which can be examined closely by the public, exposed in urban, industrial, and marine atmospheres is sometimes over-looked. There is no alternative if the very attractive initial appearance is to be retained, and this is true of all building materials. The

TABLE II—Capitalized Costs[1] of Several Metal Roofing Materials in Various Environments

Metal	Approx. Thickness inches	Weight	Cost[2] of 5000 sq. ft.		Corrosion Rates			Capitalized Costs[8] in dollars			
			Metal	Total[3]	Rural	Marine	Industrial	Based on Depreciation Period of 50 years[9]	Rural	Marine	Industrial
		lb/sq. ft.	dollars	dollars							
Aluminum	0.032	0.451	800	1880	0.047 mpy[4]	0.110 mpy[4]	0.123 mpy[4]	2060			
Copper	0.0216 (16 oz.)	1.00	2500	3500	0.011 mpy[5]	0.036 mpy[5]	0.054 mpy[5]	3840			
Lead	0.625 (4 lb.)	4.00	4300	5300	0.008 mpy[5]	0.021 mpy[5]	0.015 mpy[5]	5810			
Galvanized Steel (1.5 oz. per sq. ft.)	0.022	0.91	580	1580	27 years to 50% Rust[6]	13 years to 50% Rust[7]	6 years to 50% Rust[7]		2150	3365	6230

[1]Jellen, F.C., Next Time Use Capitalized Costs. Chemical Engineering, February 1954.
[2]Based on warehouse prices at 13 January, 1958. Freight and sales tax not included.
[3]Assumed labour, profit and overhead of 1000 dollars same for all materials.
[4]ASTM Special Technical Publication No. 175. Symposium on Atmospheric Corrosion of Non-Ferrous Metals. 29 June, 1955. Corrosion rates based on average penetration determined by metallographic examination.
[5]Ibid. Corrosion rates based on weight loss.
[6]Estimated value because ASTM data not yet available.
Report of Committee A-5, Subcommittee XIV. ASTM Proceedings, vol. 54, 1954, 110.
Based on money at 5% interest.
Aluminum, copper and lead all last longer than 50 years but the normal depreciation period for most buildings is 50 years.

work required to maintain the appearance indefinitely is only nominal in extent, particularly if started as soon as the material is placed in service and continued regularly. Numerous cleaning and protective treatments can be applied, but one of the simplest is to use a "lacquer wipe". The cloth, wet with the solution of a good lacquer diluted one part to three parts with the correct thinner, is wiped over the surface. This treatment not only loosens and removes the dirt particles, but leaves a thin, clear, protective, non-oily film. A thicker and more protective film can be obtained by wiping the surface with another rag dipped in the same solution. The frequency of this treatment will vary with the exposure conditions but generally should be done about every four months in an urban atmosphere.

Anodic coatings may be coloured with organic dyes, inorganic pigments or by means of alloying additions. A wide range of attractive colours can be produced, many of which are suitable for outdoor exposure. The use of proper dyes, thick anodic coatings, and the application of lacquer, particularly of the methacrylate type, will enhance the service life of coloured anodic coatings exposed to the weather. There has been much discussion about the outdoor use of coloured anodic coatings on aluminum alloys and claims have been made about the "life-time" retention of the original colour. The following facts are pertinent to this application:

(1) All commercial coatings weather to some degree when exposed outdoors for prolonged periods.

(2) Weathering of the anodic coating will effect the colouring material regardless of its composition.

(3) All organic dye-stuffs fade to some extent on exposure to light.

(4) Outdoor exposure in an urban environment will soon produce an adhering layer of oily soot and dust which will affect the visible colour. Unless this material is removed periodically, pitting attack will initiate.

The use of porcelain-enamelled aluminum in the construction industry is expanding rapidly. There is a good range of colours available which have excellent resistance to fading and weathering. The coatings are very adherent and the metal may be bent and cut without impairing the coating. Much work is being done, principally by the supplier of the enamelled frits, on the porcelain enamelling of aluminum.

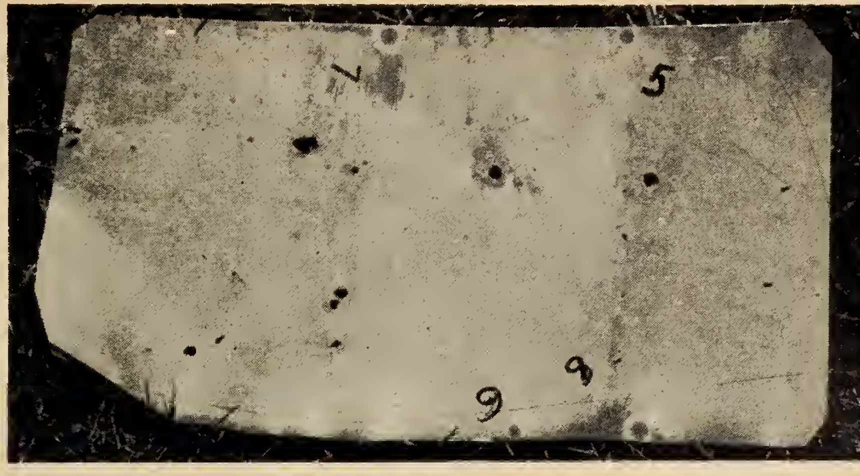


Fig. 11. Close-up view of corroded parapet flashing.

Fig. 12. Close-up view of reverse side of parapet flashing. Note ghosts of tile ribs and mortar joints. Sheet was not back-painted.

Cost of Corrosion

Corrosion and measures to combat it cost billions of dollars a year in Canada and the United States. In considering the cost of corrosion, the following factors are important:

(1) Initial cost.
(2) Cost of maintenance.
(3) Cost of replacement.
(4) Loss of production or revenue during repair or replacement.
(5) Inconvenience to occupants during repair or replacement.

The relative capital costs of metal roofing in various environments is given in Table II. The term "capital cost" means the money that must be available now to put on the roof, and to provide a sufficient sum to replace the roof at the end of its service life. From Table II it can be seen that the cost of aluminum is very much lower than that for copper or lead in all types of environments. The cost of galvanized steel used in rural atmospheres is close to that of aluminum while in marine and industrial atmospheres the capitalized costs of galvanized steel are much higher. The figures used in Table II do not include freight allowance, and assume that the installation costs are the same for the heavier metals as they are for aluminum. While the above example deals with metal roofing the same may be applied to other applications in the construction industry.

Prevention of Corrosion

Corrosion can be prevented by following good practices which have long been accepted by the building industry. These practices are the result of applying common sense in the use of the various building materials so that each material is used to its best advantage. With aluminum the following factors are the most important.

Selection of the proper alloy for a given application is important. The alloys offered for architectural uses by the manufacturers all have good corrosion resistance for normal purposes. When special conditions are to be encountered in service the advice of the metal supplier should be sought. Good design will eliminate direct contact of unpainted metal with masonry, wood, and metal surfaces. Where aluminum must be used with these materials, it should be separated from them by an underlay of asphalt-saturated and coated building paper or felt or by back-painting the aluminum with bituminous paint. Aluminum should not be used in contact with copper or copper alloys or where water can run from them on to the aluminum. Crevices can be eliminated or if this is not possible they can be filled with mastic sealing compound. Good drainage will eliminate stagnant pools of water. During construction it is important to follow the instructions of the designer. Also, many of the suggestions contained in this paper will be of use during the construction stage.

Regular maintenance will help aluminum retain its original appearance, when this is desirable. The type and amount of maintenance will vary with the environment and the location of the aluminum. Aluminum can be cleaned using water, a detergent, and mild abrasive, such as pumice. If necessary, the clean surface can then be covered with wax or lacquer as mentioned earlier. Thicker coatings of lacquer can be applied, but can not be expected to last more than about two to four years.

When aluminum is painted it is usually for aesthetic reasons, rather than for corrosion prevention. In general, a paint system on aluminum will last longer than a similar system on steel, because, if moisture permeates the paint film, it has less action on aluminum than on steel. The painting of aluminum is simple and satisfactory since suitable techniques and paints exist. It is essential that the surface be clean prior to painting, and proprietary cleaning agents containing phosphoric acid aid paint adherence. The recently developed wash primers provided an excellent base for subsequent paint systems. A general review of the subject has been published. [12]

References

(1) Walton, C. J.; Sprowls, D. O.; Nock, J. A. Jr.; Resistance of Aluminum Alloys to Weathering. Corrosion, 9, (345-358) (1953).

(2) Walton, C. J.; King, William; Resistance of Aluminum-Base Alloys to 20-year Atmospheric Exposure. American Society for Testing Materials, Special Technical Publications No. 175, Symposium on Atmospheric Corrosion of Non-Ferrous Metals, (21-44), June 21, 1955.

(3) Sawyer, D. W.; Brown, R. H.; Resistance of Aluminum Alloys to Fresh Waters. Corrosion, 3, (443), 1947.

(4) Porter, F. C.; Hadden, S. E.; Corrosion of Aluminum in Supply Waters. J. Appl. Chem., 3, (385), 1953.

(5) Aluminum Company of America; Let's Look at the Record. 1944.

(6) Logan, K. H.; Underground Corrosion. U.S. Dept. Commerce, National Bureau of Standards Circular C450, (125-7, 142, 262), 1945.

(7) Gilbert, P. T.; Porter, F. C.; Tests on the Corrosion of Buried Aluminum, Copper and Lead. British Iron and Steel Research Association, Special Report, (45), 1952.

(8) Private communication to the author. 1954.

(9) Godard, H. P.; Winslow, K. W.; Underground Corrosion Tests on Aluminum Alloys at Wright Hargreaves Mine. Canadian Mining & Metallurgical Bulletin, 43, (390), 1950.

(10) Wright, T. E.; Jenks, I. H.; Godard, H. P.; The Resistance of Aluminum to Concrete and Some Other Alkaline Building Materials. The Engineering Journal, 37, 10, 1954.

(11) Wright, T. E.; An Unusual Case of Corrosion of Aluminum Conduit in Concrete. The Engineering Journal, 38, (357-1362), October 1955.

(12) Anonymous. The Painting, Enamelling and Lacquering of Light Metals. Light Metals, 8, (144) 32, 1950; 8, (145) 84, 1950.

The following articles are recommended for general background information on the corrosion behaviour of aluminum:

(13) Mears, R. B.; Brown, R. H.; Resistance of Aluminum Base Alloys to Marine Exposure. Society Naval Architects and Marine Engineers, November, 1944.

(14) Dix, E. H.; Corrosion of Light Metals (Aluminum and Magnesium). American Society for Metals, (131-176), 1946.

(15) Mears, R. B.; Brown, R. H.; Designing to Prevent Corrosion. Corrosion, 3, (97-120), 1947.

(16) Walton, C. J.; Englehart, E. J.; Performance of Aluminum Alloys in Marine Environments. Soc. Nav. Archit. and Mar. Engrs., November 1949.

(17) Godard, H. P.; The Atmospheric Corrosion of Architectural Metals. The Engineering Journal, 36, (844-854), July 1953.

(18) Binger, W. W.; Wagner, R. H.; Brown, R. H.; Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres. Corrosion, 9, (440-447), 1953.

(19) Reinhart, F. M.; Recommended Design Details to Reduce Corrosion. Product Engineering, 1953 Annual Handbook, (610-611).

(20) Godard, H. P.; The Corrosion Behaviour of Aluminum. Corrosion, 11, (54-64), 1955.

(21) Spooner, R. C.; Loucks, J.; Present Practices and Future Trends in Finishing Aluminum. Modern Metals, 12, 7, (62-70), 1956.

Design and Operation of an Effluent Disposal System

J. C. Langford,
Production Manager, Canadian Chemical Company Limited, Edmonton, Alta.

Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June, 1957.

The disposal of industrial wastes is becoming a problem of increasing importance in the location and operation of chemical and other industries. The solution to this problem requires careful analysis for each individual situation.

The design, construction, and operation of a high odour effluent disposal system comprising holding tanks for evaluation and a disposal furnace are described.

THE CHOICE of an economic location for a plant depends on a great number of factors. Most of the recognized authors on the subject attach some degree of importance, however minor, to the economic effect of the problems of waste disposal. It is becoming evident that this factor is far too often treated too lightly or even ignored. The costs involved in properly controlling effluent to avoid contamination of ground waters and air pollution make it an economic factor which may affect seriously the choice of a plant location and influence process design.

Over the years municipal engineers have developed processes and equipment for treating the domestic effluents from our large urban centres to render them harmless to the surface waters into which they are usually discharged. Only in relatively recent years has it been necessary for engineers in industry to devote a considerable amount of study to the problem of the effect of effluent and waste disposal on the economics of a proposed or existing plant. The stage has now been reached where not only is plant location strongly affected but also the actual design, or choice of the process to be used.

In the chemical industry the problem is particularly difficult. The majority of chemical processes are designed to return a high percentage of the water required for their process needs to the waste effluent streams, but in so doing many undesirable components are included which may cause an extreme contamination problem.

It has been estimated that the contamination due to industrial sewage is roughly equivalent to the total discharge as a result of the human population, in the United States. Canada, because of its smaller industrialization, might be considered in a better position, but since our primary raw material processing industries are a proportionately higher percentage of our total industrial effort, this figure may well be true for our country as well. The methods used, to render innocuous domestic sewage, are not usually effective with industrial wastes and new methods must be devised to handle them, the development of which tax the total range of available technical skills.

Governmental agencies, municipal, provincial and federal have not as yet established fully criteria for control of industrial disposal in all locations and it is an essential responsibility of industry itself to take a leading part in eliminating and controlling pollution in an effective manner.

Each industrial disposal problem is unique, not only from the standpoint of the process differences, but also from the natural facilities available for disposal. In spite of this great variability of conditions, the problem usually can be broken down for solution into four main components. They are:

(1) Separation
(2) Collection.
(3) Storage.
(4) Disposal.

To point out the magnitude of the job of industrial disposal of effluent, the solution to the problems involved in the Edmonton Plant of Canadian Chemical Co. Ltd. will be discussed as an example.

Separation

The plant in Edmonton consists of three distinctly different types of processing units as well as a completely self-contained utilities facility. Operating are, a large and highly integrated petro-chemical plant, a plant for the production of cellulose acetate, and a yarn plant in which textile fibres are produced. The first named unit presents the most difficult waste problem in that it produces a wide variety of chemicals which are separated and purified from aqueous solution by more or less conventional techniques of distillation, extraction, filtration, etc. The difficulties here lie in the fact that trace impurities in the form of complex organic chemicals appear in almost all waste streams from the process. They are of such a variety and of such complexity that it is an almost hopeless task to attempt their ultimate removal from the aqueous waste by distillation, extraction, etc., or by chemical destruction or conversion.

It is necessary to take a very empirical approach to the problem and to segregate as rigidly as possible the waste streams at their source. In this manner, the volumes of undesirable wastes are kept to a minimum and can be dealt with. In actual practice, installations have been made which segregate, by means of sumps, pump gland drip pans, etc., extremely small amounts of contaminated waste at the source, in order that the material will not mix with larger volumes of "clean" wastes and thus increase the total volume of contaminated material for ultimate disposal.

Wastes of a contaminating nature are of two general categories, those which have a high odour and those which have a high bacteriological oxygen demand.

Collection

The plant as it is now constituted contains the following eight types of separate sewage collection systems; in some cases more than one piping system exists for each type.

(1) A storm sewer system for all surface run-off.

(2) A sanitary sewer system with septic tank for sanitary sewage.

(3) Complete process sewer systems carrying material from floor drains in clean areas or from clean process waste streams.

(4) A separate sewer system carrying process waste streams which may by their nature, be contaminated by high odour materials from time to time.

(5) A separate sewer system into which is discharged process waste material or drainage which usually contains high odour contamination.

(6) A separate sewer system containing process waste material which has a high bacterialogical oxygen demand. B.O.D.)

(7) A separate sewer system used to convey material which is rich enough in hydrocarbons to be flammable.

(8) Provision of truck transported liquid collection containers at certain locations where piping is not economical.

Storage and Disposal

The storm sewage system is conventional except that all drop inlets in areas draining tank farms, pipe racks, etc. are provided with a retaining ring with a normally closed control gate. With this modification protection is achieved from inadvertent spills or line breaks while normal surface drainage can be disposed of through manual operation of the gate. All storm sewage is discharged into the North Saskatchewan River.

The sanitary sewage after treatment and clean process sewers are allowed to discharge directly into the river, although a rigid sampling and evaluation procedure is followed to assure these streams remain low in both odour and B.O.D.

The possibly contaminated process waste stream is pumped into large tanks of sufficient capacity to hold over 24 hours total effluent. It is held in these tanks until it can be sampled and odour determinations made. If the results of these tests are satisfactory, it is released under control to the river, if not, it is pumped to one of the two so called high-odour ponds on the property, where it is impounded.

The fifth type of effluent disposal, that of process high-odour material is made to one of the above mentioned impounding basins. The sixth form of sewer system which contains high B.O.D. material is piped to discharge into a completely separate impounding basin. Disposal from these impounding basins is described later.

The seventh sewer system, that for combustible wastes, discharges alternatively into storage tanks or to a burning pit where it is burned as it is produced.

Material collected in the containers referred to in (8) above is carried by trucks to burning pits or impounding basins, depending on the composition, for disposal.

During the winter periods of low river flow, when the plant usage of water and hence the total effluent may be of the order of 1% of the total river flow, only clean streams are discharged to the river. Composite samples are taken and evaluated daily from these streams and all their contributary branches to enable the closest control.

A new installation has recently been made in the form of an effluent furnace in which the combustible effluent mentioned above is burned and into which is atomized the impounded high-odour material. The furnace is so operated that the material is not only vaporized but the vapour raised to a temperature at which the true organic material present is oxidized or otherwise broken down to odourless material. It has been found that, under the conditions at Edmonton, a stack temperature of 750°F. is sufficient to accomplish this destruction and prevent air pollution. This type of furnace is relatively new and it was necessary to build a pilot unit and conduct extensive development work before the full scale design could be made and the furnace constructed. A view of the furnace in operation is shown in Fig. 1. It is designed for a heat release of over 15,000,000 Btu/hr.

The impounded high-odour material is disposed of by three methods:

(continued on page 60)

Fig. 1. View of effluent disposal furnace in operation.

Selection of the Trans-Canada Highway Route Through the Selkirk Mountains

J. P. Hague

Senior Location Engineer, Department of Highways, Province of British Columbia

Read at the 71st Annual General and Professional Meeting of the Engineering Institute of Canada, Banff, Alta., June, 1957.

SOME SEVENTY-five years have passed since Major Rogers and his associates explored unknown passes through the Selkirk Mountains for a transcontinental railway route. Adventure such as this is a thing of the past. Nowadays we benefit from the experience and knowledge accumulated by those who have passed before. Access problems are now relatively easy. We have the use of air reconnaissance, aerial photography, aerial mapping, and such facilities as the helicopter, motor vehicle, swamp buggy, snowmobile, tractor, outboard motor, etc. However, even with all these modern day aids, the choice of a single all-weather route through one of our most rugged mountain ranges, was a major engineering undertaking.

Before analysing the various passes through the Selkirk Mountains, we will first consider the existing route of the Trans-Canada Highway. This highway, commonly known as the Big Bend, follows the Columbia River Valley for its entire length from Golden to Revelstoke. It was completed in 1939 and has been subsequently improved to its present condition as a second class gravel-surfaced road.

Advantages in favour of this route are: it circumvents the Selkirk Mountains along a water level route; it can readily be constructed to Trans Canada Highway standards for a lower average cost per mile than any alternate route; it can provide superior alignment gradients and geometric design to any alternate route; snowfall is no more serious, and in most winter seasons somewhat less than any high level route, while avalanche or snowslide conditions are practically negligible, resulting in lower average per mile winter maintenance costs; temporary closure of the highway due to hazardous conditions are practically non-existent.

The main disadvantages of this route are: the total distance from Golden to Revelstoke along the Big Bend Highway is 196 miles, as compared to a distance of 88 miles via the Canadian Pacific Railway and Rogers Pass; only a very small portion of the existing highway could be utilized in the relocation of this route to Trans Canada standards; there is no doubt that a high level storage dam will eventually be constructed at Mica Creek which would make the relocation of the highway above the flood level extremely difficult and costly. The Department's estimate for reconstruction of the Big Bend route to Trans Canada standards, not considering the proposed dam, amounts to approximately $31,000,000. This estimate is based on 60 miles of final location and a thorough knowledge of the terrain over the entire route.

Even with the aid of modern engineering methods and equipment, the selection of an all-weather route through one of Canada's most rugged mountain ranges was a major undertaking.

Factors instigating the investigation of alternate routes were:

(1) whether a shorter route with its resultant economy in maintenance and vehicle operation, although more costly per mile to construct, could be constructed for a similar overall cost, due to reduced distance;

(2) the consideration of Mica Dam.

In 1952 the Provincial Department of Highways undertook preliminary investigations of all possible highway routes through the Selkirks in the area bounded by the Big Bend on the north and the Canadian Pacific Railway on the south. A study of aerial photography and a reconnaissance by air eliminated further consideration of a route via Downie Creek, Sorcerer Creek, Bachelor Creek, and Gold River, and also a route via Goldstream Creek, Moberley Pass (elev. 5825 ft.), and Gold River. A route via the Illecillewaet River, Tangier Creek, and Mountain Creek to Beavermouth appeared feasible and worthy of ground investigation. A reconnaissance was therefore undertaken by Mr. Norman Zapf, Assistant Location Engineer, Department of Highways, Victoria, assisted by Mr. Scarborough of our Location Branch, accompanied by a guide and packers. The route was thoroughly examined on the west side of the range to the summit. Most significant was the fact that no water course or valley led directly to the summit, forcing any proposed location to traverse the mountain side on steep rock slopes of 50°-60° and using maximum grades of 7% to 8% for approximately seven miles to reach the high levels. In addition, some extremely heavy work would also be encountered in the lower Tangier Valley. These features, coupled with the existence of many large slide areas on both sides of Tangier Creek, proved the route to be economically impractical to construct, or maintain a safe all-weather highway. Final conclusions were that there are no feasible highway routes through the passes of the Selkirks north of the Canadian Pacific Railway.

Preliminary Investigations

The Department had also carried out a very preliminary investigation of the Rogers Pass route without reaching any definite conclusions. As a decision on the route for the Trans Canada Highway was becoming vital, a reconnaissance of the entire Rogers Pass route was undertaken by the Federal Government. Messrs. W. J. Bishop and G. N. Brittain, of the Trans Canada Highway Division, carried out the reconnaissance survey during the summer of 1953. Their report revealed that a route from Golden to Revelstoke, via Rogers Pass, was entirely feasible. It indicated reasonable construction costs, availability of good construction materials, the possibility of standard geometric design, and the feasibility of combating snow conditions. It was therefore concluded that this route, with a total length of 88 miles, and an estimated cost of $28,000,000 would be superior to the Big Bend route.

At about the same time representatives were received from Boards of Trade, and other organizations, in the West Kootenays and the Lake Windermere area, to consider a route via Jumbo Pass, some 80 miles south of Rogers Pass and through the Purcell Mountains. This route contemplated leaving the present Trans Canada Highway at Eisenhower Junction, following the existing park road through Kootenay National Park to Radium Hot Springs and Invermere, westerly through the range via Jumbo Pass to the south end of Duncan Lake, and northwesterly along the Lardeau River, Trout Lake and Columbia River to Revelstoke. Consequently, in the summer of 1954, Mr. Zapf, accompanied by Mr. Scarborough and Mr. F. Feuz, of Golden, undertook a reconnaissance on foot from Invermere, via Toby Creek and Jumbo Creek to Jumbo Pass, thence down Glacier Creek to Howser at the south end of Duncan Lake. Results of the survey showed Toby Creek and Jumbo Creek to be reasonably wide "U" shaped valleys, and while they presented some minor difficulties, a high standard highway could readily be constructed to the base of Jumbo Pass. On the other hand, Glacier Creek valley is a typical Selkirk "V" trench with steep rock slopes, and an average gradient of 4%, leaving little flexibility to avoid difficult sections.

The most difficult obstruction, however, is encountered in the area of the pass itself. Jumbo Pass, which could be more correctly named Jumbo Ridge, is actually a narrow hogsback, 7500 ft. high, between two flanking mountains, Jumbo to the north and Earl Grey to the south. Both water courses, Jumbo Creek on the east side and Glacier Creek on the west, fork to the north and south at the base of the ridge. The elevations of the forks are 5000 ft. and 4500 ft. respectively. A highway over the summit would have to overcome 2500 ft. in elevation on the east approach by looping up the North Fork of Jumbo Creek through large slide areas, snow cols and a glacier. The west approach presents an even more dismal picture, in that the lack of distance, the tremendous slide area on the west slopes of the South Fork of Glacier Creek, and the close proximity of the glacier, discourages any notion to climb to the summit at all. The only plausible solution, then, was to use what distance was available from the forks of the creek to rise as high as possible and tunnel through the ridges. It was possible to reach a maximum elevation of 5300 ft. on the west side and 5500 ft. on the east side, resulting in a tunnel on a 2% grade at least two miles in length which would require lighting and a ventilation system. As a result a decision was reached that Jumbo Pass should not be considered as part of the Trans Canada route, but that providing a tunnel was acceptable, the route was feasible and might be worthy of further consideration at some future time if development of the Province indicated the necessity of another highway connection from the Columbia Valley to Kootenay Lake.

Apart from a comparison of costs and topographic features of Jumbo Pass and Rogers Pass routes, other factors such as traffic origination and destination, distance, and vehicle operation costs, must be considered. There is no doubt that a highway through Jumbo Pass would benefit the residents of the West Kootenays. Unfortunately, however, only one route through the Selkirk Mountains can be justified or financed at the present time. With early completion of two existing bottlenecks on the Southern Trans Provincial Highway, namely, Cascade-Trail and Salmo-Creston, the West Kootenays will have direct access west to the Coast and east to the Province of Alberta. Admittedly, the route from Salmo to Calgary, via Crows Nest Pass, is some 50 miles longer than route via Jumbo Pass, but this extra distance is more than offset by superior gradients and alignment.

A study of traffic patterns indicates that, for traffic originating on Vancouver Island, Lower Mainland, the Okanagan, Fraser Canyon, Cariboo, Northern B.C., the North Thompson and Kamloops regions, with destination Banff or Calgary, the shortest and most logical route is via the Trans Canada Highway.

In considering distance, the Rogers Pass and Jumbo Pass routes have two common points, namely, Revelstoke and Eisenhower Junction. The length of route between these points is 158 miles via Rogers Pass, and some 234 miles via Jumbo Pass. Rogers Pass was chosen because of the economics involved in a reduction of some 76 miles in distance, resulting in greatly decreased estimates for cost of construction, maintenance, and vehicle operations.

Savings in Costs

As a rough example of savings in vehicle operation costs, a reduced distance of some 76 miles results in a saving of 1½ to 2 hours or more in the operating time of every vehicle passing over the highway. In operating costs, a reduction of 76 miles at some 8c per passenger vehicle mile results in a saving of $6.00 for every passenger car passing over the highway. Assuming an ultimate average daily traffic volume of 1,000 cars per day in each direction, the saving in operating costs to passenger vehicles could exceed four million dollars annually. Although we have no data at the present time on the ultimate volume of freight to be hauled over this highway, a reduction of 76 miles in distance would greatly reflect on the cost of freight carried.

Although the reduction in highway mileage via Rogers Pass is some 76 miles, the reduction in mileage of Provincial highway via this route is some 99 miles. This is because there is 23 miles more highway within National Parks on the Rogers Pass route. This reduction of 99 miles of Provincial highway means a saving of from $300,000 to half a million dollars, annually, to the Province in maintenance and snow removal costs.

Comparing the mileage of highway to be constructed or reconstructed via either route, we have the following comparison.

Rogers Pass Route

The section from Golden to Eisenhower Junction is already reconstructed to Trans Canada standards or work is committed. This leaves a distance of 90 miles to complete or reconstruct, including the 16 miles of existing road from Golden to Donald.

Of the 90 miles total distance, 27 miles lie within the Glacier National Park and 8 miles within Revelstoke National Park, which the Federal Government is committed to build. This leaves a distance of 55 miles to be constructed and maintained by the Provincial Government, with contributions by the Federal Government of from 50% to 90% of the cost.

Jumbo Pass Route

Jumbo Pass route from Eisenhower Junction to Revelstoke is a distance of some 234 miles, of which 68 miles lie in the Kootenay National Park. This 68 miles would have to be reconstructed by the Federal Government to Trans Canada Highway standards. The remaining 166 miles of this route would have to be constructed and maintained by the Provincial Government.

Throughout the provincial section almost none of the existing local mining roads and trails, etc., could be incorporated into a Trans Canada highway design. They would only prove useful as access to construction.

The section of the route along Toby Creek and Jumbo Creek is certainly feasible, and compares favorably with our sections of the Rogers Pass route. However, as previously mentioned, at an elevation of 5500 ft. it is necessary to tunnel through Jumbo Ridge for a distance of two miles in order to overcome gradients not acceptable to major highway standards. The tunnel, complete with ventilation equipment and lighting, could cost up to ten million dollars.

From the west portal of the tunnel the highway would have to traverse the Glacier Creek Valley for some 20 miles to Howser, at the bottom of the Duncan Lake. Because of the steep nature of the valley, it would be difficult and very costly to construct a highway to Trans Canada standards for gradient and alignment through this section, and maintenance costs would be heavy.

The remainder of the route from Howser to Revelstoke is entirely feasible, with normal construction, with the exception of a heavy section along Trout Lake and a most difficult section between Beaton and Arrowhead.

It is therefore considered that initial capital expenditures, future maintenance costs and future vehicle operation costs for the Province as a whole, justify the decision to adopt the Rogers Pass route.

Field Location of Rogers Pass Route

For the purpose of discussion, the Rogers Pass route can be divided into three sections, namely: Revelstoke to the west boundary of Glacier National Park, a distance of 28 miles; Glacier National Park which includes Rogers Pass proper, a distance of 27 miles; and the east boundary of Glacier National Park to Golden, a distance of 35 miles.

During 1955 and 1956 the Federal Government carried out the location survey through Glacier National Park and this is nearing completion. Contracts for right-of-way clearing are already under way. The Provincial Department of Highways commenced the location survey in the Illecillewaet Valley in the late fall of 1955 and again in May of 1956. The section from Revelstoke to the West Boundary of Glacier Park was completed in 1956, with exception of four miles which has been finalized this spring. The design, specifications, and estimates of cost for three sections, each approximately six miles in length, have been completed and awarded to contract. The remaining section will be finalized and advertised for tenders next month. The centre section, some seven miles in length, which is in Revelstoke National Park, will be handed over to the Federal Government for contract. On the easterly section contracts have been awarded for approximately 15 miles from Golden to Donald and location parties are presently on the ground to complete the gap from Donald to the East Boundary of Glacier National Park for construction in 1958.

To facilitate the surveys, aerial mapping at a scale of 1,000 feet to the inch with 25 foot contour interval was obtained. All feasible highway alignments were projected on this mapping along both sides of the Illecillewaet valley, including feasible crossovers from one side of the valley to the other. These various projections were then investigated from the air by helicopter, giving careful attention to control points, the number of slide areas, bridge sites, major drainage features, degree of side slopes, and types of materials. Following this a detailed ground investigation of these various control features, classification of materials, drainage, etc., was carried out by Mr. Zapf, Mr. Scarborough, the author, and Mr. Perkins, who was to be in charge of the field surveys. A review of all the features investigated by these individuals enabled us to determine the best general alignment for the survey, it being unanimously agreed that the route along the north side of the valley throughout was the best and most economical location.

The main features governing the selection of the north side of the valley were:—to avoid the construction of two tunnels which would be required on the south side, one to achieve good alignment and the other above the Laurier Tunnels where some 3,000 feet of tunnel could be the only means of crossing the slide area; to avoid close proximity with the Canadian Pacific Railway and its resulting construction, maintenance, and snow removal problems; to avoid areas of wet sidehill which is much more prevalent on the south side of the valley; to utilize the definite advantage of a southern exposure; to achieve generally better alignment. The above mentioned features favouring the north side of the valley are offset somewhat by the fact that the selected route must cross three important slide areas between Illecillewaet Station and the west boundary of the Park, where it appears certain that several hundred feet of permanent snow sheds will be necessary.

The only section where some doubt existed in the initial studies was between Greely and Twin Butte. Some preliminary surveys indicated the alignment was somewhat easier on the south side of the valley through this area. However, as this proved to be a wet sidehill and as the location would be directly above the Canadian Pacific Railway, we could foresee difficulties during construction, and future maintenance problems resulting from an unstable roadbed. Therefore, as the north side had definitely been selected from Twin Butte easterly, and from Revelstoke to Greely, it was decided to utilize the north side between Greely and Twin Butte. Any additional costs resulting from heavier grading would be more than offset by the elimination of two grade separations with the railway, and two major river crossings, and a more stable roadbed with better exposure would be achieved.

In order to complete the survey of the Illecillewaet in one year, three survey crews were employed under the direction of a location engineer. One of these crews worked from Revelstoke and established the location from the west side of Revelstoke easterly to Greely and beyond as far as road access was available. The other crews located the remaining section to the Glacier Park boundary where access to the survey line was difficult. Both these crews operated from tent camps at sidings along the railway and were each equipped with a cookhouse and an office erected on flat cars.

Results of this survey indicate that construction costs through the Illecillewaet section of this highway will be generally less than Trans Canada Highway reconstruction through the Fraser Canyon.

Survey of Snow Conditions and Avalanche Activity

Snow surveys were commenced during the winter of 1953/54 and the work accelerated during the past winters. The survey is under the personal direction of Mr. Noel Gardner, who is an authority on snow conditions, having been employed as a Park Warden in Banff and Glacier Parks for some twenty years. Mr. Gardner has studied snow conditions and control of avalanches for a number of years and has attended courses conducted at the University of Utah.

Prior to last winter (1956-57) these surveys consisted of frequent visits to the slide areas to record the incidence, types, depths and extent of the slides. Last winter a permanent base was established at Glacier with observation posts located on the Bear River in Rogers Pass and on Mount Abbot at an elevation of 7000 feet.

Several experienced mountain climbers and skiers are employed on Mr. Gardner's crew, and the necessary equipment has been provided to accurately record temperatures, relative humidity, wind velocity and direction, snowfall, depth and density of snow, and a careful continuous record is kept of the condition of the snow in the trigger zones of the slides. Data is also recorded on the occurrence of avalanches, such as time of day, location, width and depth of slide, type of avalanche, and cause.

These studies already indicate that an experienced crew attached to the maintenance group after completion of the highway will be able to very closely predict the periods when hazards exist so the road may be closed for a short period until conditions change or the slides are brought down by explosives or mortar fire.

Mr. Gardner has also conducted some experiments in stabilization of slide areas, and construction of terraces with bulldozers across the slide area has been tried with success in some places. These experiments and surveys will be continued until the most economical method to protect the highway public at each particular slide can be determined. The use of terracing where feasible, snow stabilization, and short closures of the highway may greatly reduce the amount of snow sheds to be constructed. As permanent concrete structures cost some $3,000,000 per mile, this is a most important consideration. It is therefore not intended that any snow sheds will be designed until the grading work is completed.

EFFLUENT DISPOSAL SYSTEM

(continued from p. 56)

(1) by destruction in the high-odour effluent furnace described above;

(2) by solar evaporation from the ponds. (In Edmonton we lose up to 2 in. per week for the summer months with a yearly total of approximately 20 in.);

(3) by carefully controlled discharge to the river during summer high river flow periods when adequate dilution of odour values can be maintained.

The impounded high B.O.D. material is also released under careful control during the ice-free and high-flow months when there is adequate oxygen in the river to accommodate the effluent.

In design of any new facilities or alterations at the plant, one of the prime criteria has become the necessity of choosing designs and processes which produce, if possible, no contaminated effluent. If this is not possible, every effort is made to provide, from the beginning, facilities for isolation of any contamination from clean streams, economic collection, storage, and disposal.

An expenditure in the order of $500,000 has been made in providing for the elaborate precautions described above, however the type of facilities involved permit operation at full and expanded scale while enabling the plant to meet not only present restrictions on effluent disposal to the river but also any future conditions which are felt may arise. Facilities of this nature are definitely a factor in the economics of the operation, not only of this plant, but of any plant which faces similar problems. The most serious consideration and skillful design must be applied to this facet of industrial operation to avoid the inevitable results of indiscriminate effluent contamination. The time is already past in Canada when industrial pollution is someone else's problem.

Marginal Punched Cards for a Reference File in the Field of Electronics

W. G. Hoyle

Radio and Electrical Engineering Division, National Research Council, Ottawa, Ont.

As an improvement on the card reference information file commonly used by engineers, a modified system using marginal punched cards is described. This punched card system enables information to be retrieved from a file on the basis of several classifications. Specifically, the system described uses date, authors, subject matter, source, and miscellaneous. Combined selections using any of the above bases are both possible and extremely useful. Rapid collation of the cards, either chronologically by date, or alphabetically by author, is possible. Normally the cards are not kept in any particular order. Only one card is used per reference and costs are similar to those of the more common card file systems.

MOST ENGINEERS, or groups of engineers, in today's rapidly expanding electronics field find it desirable to maintain some sort of card index file of information which they require to be at their finger tips. Such files eventually develop, in most cases, into one of two basic types. First and simplest is a reference file with cards arranged alphabetically by the name of the author (first author, if more than one); the second type has a card for each author and additional cards for subject headings.

Chief merit of the first type is that cards are added with little effort; its disadvantage — with the passage of time the file becomes larger and authors' names are forgotten so that eventually a card cannot be located when wanted. The second type, with multiple cards, requires much work each time a reference is added to the file, for since multi-author papers are common, and since papers are seldom limited to a single clear-cut subject, as many as seven cards may be needed for one reference. In addition, preparation of a subject index requires considerable time and skill, so that even this second system does not always function well.

The system to be described has all of the advantages and none of the disadvantages of the above systems. In addition, it has some merits possessed by neither.

1. Only one card is needed for any reference or abstract.
2. This card can be selected from the file in a multiplicity of ways, specifically by:
   - (*a*) name of first or second author,
   - (*b*) any one of several subject headings,
   - (*c*) date,
   - (*d*) source, i.e., origin or name of publication,
   - (*e*) several miscellaneous items, such as being in a foreign language, or being confidential information.
   - (*f*) combinations of items (*a*) to (*e*) above. For example, (*c*) and (*d*) could be used to select all cards from a given publication for some particular year.
3. Cards need not be kept in order. Obviously, therefore, they cannot be misplaced or lost (at least not in the file!). Cards can be put in order, when desired, at a rate of several hundred per minute. They can be arranged chronologically by date, or alphabetically by first or second author.
4. The subject index is prepared using the accumulating cards as a guide. That is, the selection of subject headings can *follow* the acquisition of the cards. When the cards in some category become too numerous for convenience they are examined for ideas by which to classify them. It is far easier to choose suitable categories for existing items than to create categories in advance. Theoretically suitable headings never seem so suitable when actually put to use.
5. No dependence is placed on memory, and no separate subject lists or subject guides are used.
6. The system is so simple that trained clerical services are not necessary, and no "operator" need intrude between the user and his cards. On the other hand, the work can be done altogether by clerical help (other than the actual abstracting of material, of course), if such help is available.
7. Cost is intermediate between that of the two basic conventional systems described in the introductory paragraph. Cards and cabinets are practically the total cost.

This improved performance is obtained by the use of punched cards; in our case by the use of marginal punched cards.

Mechanics of the Marginal Punched Card

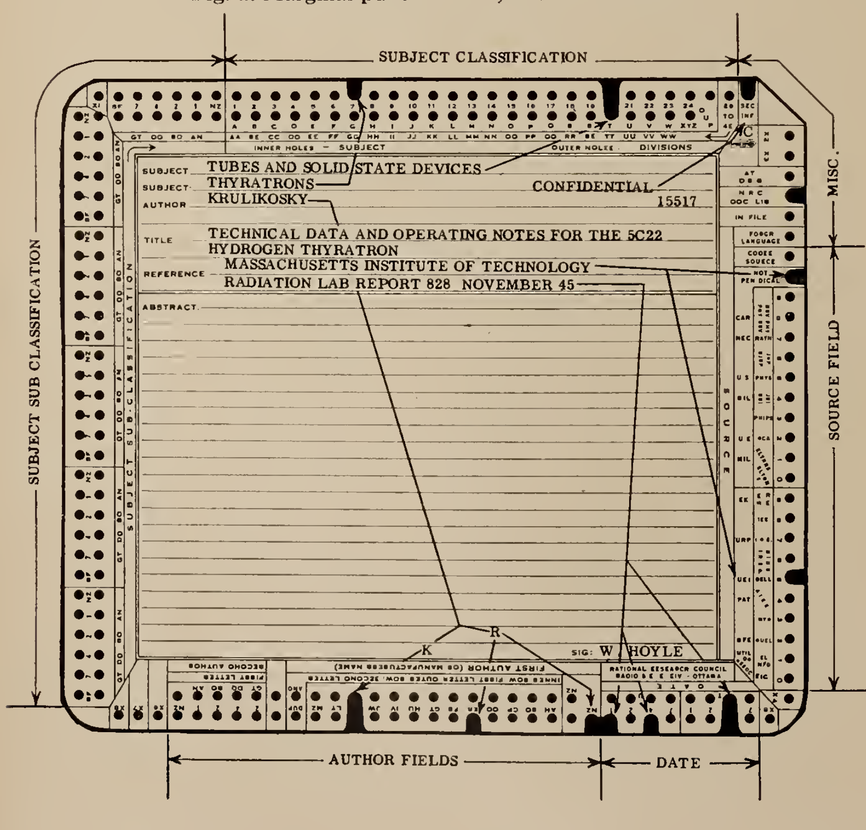
A marginal punched card is basically a common reference card in which one or two rows of holes have been punched around the edges by the manufacturer; normally there are about four or five holes to the inch. Usually there is some printed information adjacent to the holes to facilitate their use. The central area of the card is blank and is used in the same manner as is a plain unpunched card. The card in Fig. 1 is practically self-explanatory. Figure 2 shows another card as received from the manufacturer.

There is no need to use a particular size, and in fact the 5 by 8 card shown in Fig. 2 was seriously considered as an alternative. The 5 by 8 card has the advantage of being the same size as cards found in many existing card index systems using plain cards. Its use makes changeover easier since plain and punched cards could be filed together during the transition period, and existing filing cabinets could be used. The 6½ by 7½ card is somewhat easier to handle and has somewhat more holes. Two sizes are shown to illustrate the flexibility possible. Cards are available ranging from about 1½ by 3 to 8½ by 11.

On the card in Fig. 1, holes are assigned to indicate the date, the author's name, the source of the information, and the subject and its sub-categories, and so on. In use, the card material between the appropriate hole and the edge of the card is removed with a punch, much like a train conductor's punch, thus leaving a notch or slot. (Gummed patches, called "cardsavers" are available for mistakes or changes.) When a sorting needle is inserted through a hole position in a group of cards, and lifted, as shown in Fig. 3, the cards which have that hole slotted, will drop. This simple sorting method (there are more elaborate ones[1]) is well suited to files of not more than a few thousand cards. Speeds of at least 50,000 sorts per hour are customary so that for our application sorting time is trivial. The holes, then, are primarily a mechanism for selecting certain cards from a pack in accordance with a punching plan which is related to the data on the card. Cards can also be put into alphabetical or numerical order by using the punching.

Some details of the actual assignment and punching (i.e., slotting) of holes are perhaps needed. To indicate a digit we could assign ten hole positions, one to each of the digits 0 to 9, and then punch the appropriate one. Such a group (called a field) is shown in Fig. 4(a). Digits punched as described are said to have "direct" punching. Actually too many holes are required in such a system and recourse is usually made to one of the schemes of Fig. 4(b) and 4(c). Only the first five digits are shown, the extension is obvious. Systems such as those in Fig. 4 are called "coded" systems.

Fig. 1. Marginal punched card, 6½ x 7½ inches.



Sorting and Collating by Date or Author

Referring to Fig. 1, the date field consists of two digital fields of the type shown in Fig. 4(c), one field for the years, the other for the decades. (There seems little point in indicating the centuries). Only eight hole positions are used along the margin of the card whereas twenty would have been needed for the direct scheme of Fig. 4(a). As a penalty it now requires an average of three sorts to obtain a card by date, rather than the two sorts of the direct method. Besides saving holes, coded date punching has another advantage which will be seen in the following paragraph.

The date field is used not only for selecting cards of a given date, but also for arranging the cards in chronological order. Such arranging may be required in preparing bibliographies, or when considering the history of a subject. Sorting is started at the "ones" digit of the years field, and continued across hole by hole (outer holes only) to the "sevens" digit of the decade field (8 sorts altogether), the dropped cards each time being placed at the back of the pack before proceeding. The cards will now be in chronological order. There is one exception. Since 7 and 4 are punched for zero, the year 1920 for example will follow 1929 rather than 1919; the year 1930 will follow 1939 not 1929, and so on. These groups must be shifted by hand. If objection is taken to this procedure, then the card could be redesigned to include a zero hole, instead of using 7 and 4. Note that the coded scheme, using only 8 holes for the date, allows us to arrange the cards in order in 8 sorts, whereas with the direct method 20 sorts would be required.

When sorting for a card by date, it is in theory immaterial whether the year or decade hole is sorted first. For example, a card date 1948 could be sorted first for the year 8, dropping all cards 1908, '18, '28, '38, '48, and then for decade 4, thus dropping out the year 1948. Alternatively, the sort could be first for decade 4, dropping the years 1940 to 1949 inclusive, then for the year 8, giving again the 1948 group. Practically, however, the first method is much to be preferred, for the number of cards to be re-handled after the first sort is much smaller. That is, the group 1908, '18, '28, etc., is much smaller than the group 1940 to 1949. With experience many such reductions in effort can be made.

Besides the number fields so far holes, but also because occasionally it is desired to arrange cards alphabetically by author, in preparing reference lists for papers or reports. The cards are put in alphabetical order by starting at the left end of the field at letter A and sorting across hole by hole (inner holes only), the dropped cards being placed each time at the back of the pack. A final sort through the NZ hole completes the sorting. Note that only 14 sorts are required. With a direct alphabet code, 26 sorts would have been needed. If the above sorting is done

"Source" Field; Miscellaneous Items

A source classification, as shown on the right edge of the card in Fig. 1, is a most useful means of reducing the work needed to locate a card. In use, a sort through any hole position drops the cards from the sources printed opposite the hole. A second sort through the hole marked "not periodical" then separates the sources in the left column (non-periodical) from those in the right (periodical). The order of sorting can be reversed but the work is greater as a larger number of cards must be rehandled

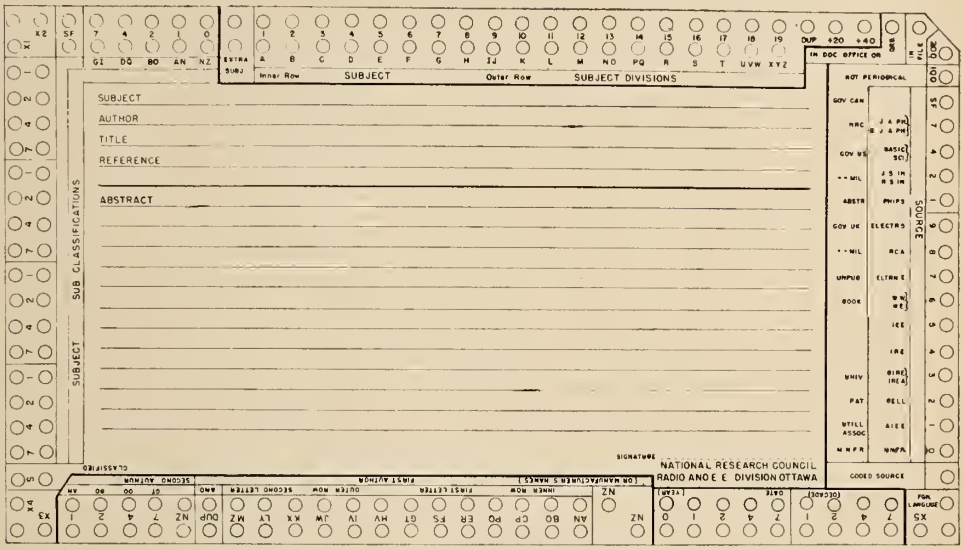


Fig. 2. Marginal punched card, 5 x 8 inches.

described, alphabetical fields are required for the author's name, etc. We sometimes use the direct method and assign a hole position to each of the 26 letters, as is done for the subject field on the card in Fig. 1. Another method which requires fewer holes, is the coded scheme shown on the card of Fig. 1 in the "second author" field. There are other five hole schemes.

Now, though with the direct scheme we use 26 holes for the alphabet, only one sort is necessary for each letter; with the 5 hole scheme, while only 5 holes are required, up to 4 sorts may be needed for one letter. For selection by author, since two letters of the name are used, 8 sorts might be required. As selection by author is frequent this number of sorts is excessive and the compromise scheme in Fig. 5(a) is preferable. Fourteen holes are needed with a maximum of two sorts per letter; the first sort selects a two letter group and this group is then divided using the "NZ" hole. This compromise alphabetical scheme is used for the first author field not only to save first with the outer holes, then with the inner holes, the cards will be alphabetically arranged by the first two letters, i.e., aa, ab, --az, ba, bb, --zz.

The author field has two rows of holes, and these inner and outer rows are used for first and second letter, respectively. Obviously interference between inner and outer rows can occur. To overcome the difficulty, the hole at the extreme right of the author field, marked "dup" (for duplicate) is punched when the second letter of the author's name has the same hole position as the first. For example, if in Fig. 5(b) the name had been Borden, then since B and O occupy the same hole position, both inner and outer hole would be punched simultaneously by the punching of the first letter. Note that the NZ hole is still punched to indicate that the duplication is for BO and not BB. The hole "ano" below that marked "dup" is for the anonymous group. When it is used, of course, the "dup" hole too is unavoidably punched but has no significance.

for the second sort. A few stray cards may be found which do not belong to the sources shown in either column; if numerous enough to be a nuisance they can be removed by a sort through the "coded source" hole. An explanation of this follows.

The number of cards from sources not shown on the card is normally small, and the hole marked "coded source", which is punched in all such cards, is generally interpreted to mean "miscellaneous sources". Such cards are normally given no further source punching. If, however, selection of cards by coded source is used, the cards from coded sources are prepared as follows; two digits, one from each of the two digital groups 0 - 9, adjacent to the source holes, are assigned to the source (in effect the sources are numbered from 10 - 99), and two sorts made through these assigned holes when the card is required. Eighty-nine sources can be coded in this fashion. The hole "coded source" need not be sorted. A list of coded sources must, of course, be kept. The list is kept on a card which has the "coded source" hole and inner "XYZ" of the subject field punched. An explanation is given later. There are some blanks left in the source field printing, so that future important sources can be added directly on card, rather than having them coded.

The source abbreviations shown have the meanings given in Table A.

In the miscellaneous field, immediately above the source field (Fig. 1), "foreign language" is self-explanatory; a third column with titles could have been added for such periodicals but it was deemed not necessary. "In file" means that a photostat, reprint, or copy of the material abstracted has been obtained and is directly available. "NRC Doc. Lib" and "at DRB" refer to the National Research Council, Radio Division Document Section, and to the Defence Research Board Library, respectively. The identification call numbers assigned at these sources are usually written in opposite the hole. In Fig. 1, for example, the number 15517 appears opposite "NRC Doc. Lib". This number, written in by the abstracter, also indicates that that hole is to be punched. The upper two holes "X2" and "X3" are extra holes to which any desired significance can be assigned, not necessarily sources.

The hole "sec inf" means that the card contains security information within the meaning of the Official Secrets Act. It is also our practice to order some cards printed in red (black is normal) and these red cards are used for all security information as a double precaution. Grade of security is indicated on the card adjacent to the hole. Included in the category could be patentable material or material confidential from a business standpoint. The word "confidential" which appears in Fig. 1 is for explanation only. Normally only the letter "C" appears, as shown immediately below the how (or else "S" for secret). This letter, written in by the abstracter, also indicates the punching.

Table A

Non-periodical sources

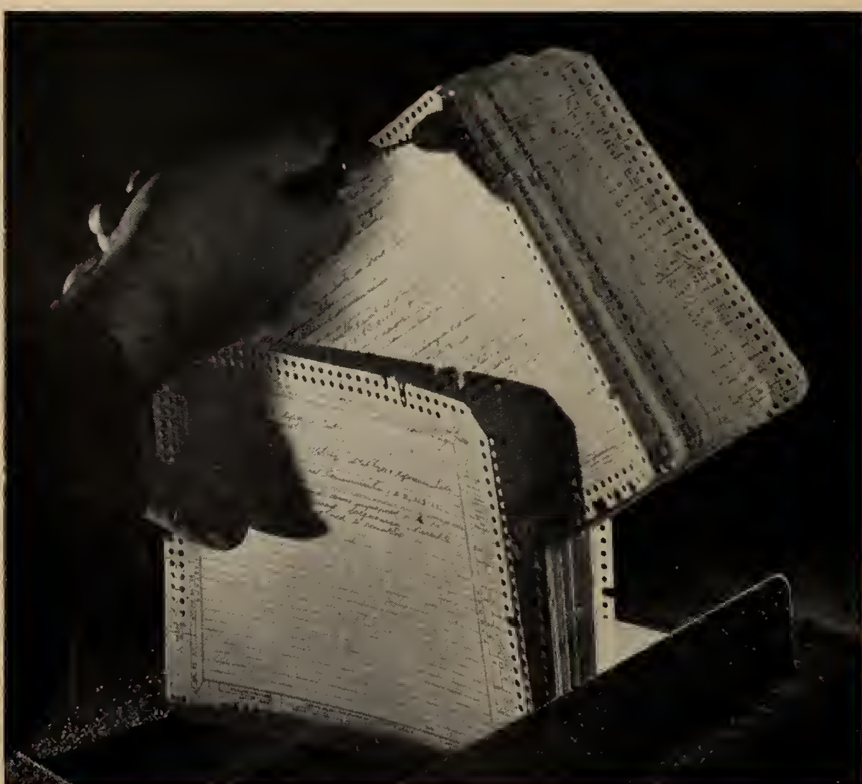
Can	Canadian Gov't Publication
NRC	National Research Council (Canada)
U.S.	United States (non-military)
MIL	U.S. Military Sources
U.K.	United Kingdom
Bk	Book
Unp	Unpublished
Univ	University
Pat	Patent
MFR	Manufacturer's literature (non-periodical)
Util or Assoc	Utility or Association

Periodicals

*[Phys. Rev.	Physical Review
Rev. Phys.]	Review of Modern Physics
Math.	All Mathematical Journals
*[JAP	Journal of Applied Physics
BJAP]	British Journal of Applied Physics
Phys	Physics Periodical (not shown elsewhere)
*[RSI	Review Sci. Instr.
JSI]	Journal Sci. Instr.
Phips	Philips (Gloeilampenfabriken and affiliates)
RCA	Radio Corp. of America
Electrns.	Electronics
Electrn. E.	Electronic Engineering
*[WE	Wireless Engineer
WW]	Wireless World
I.E.E.	Institute of Electrical Engineers of Gt. Britain
IRE	Institute of Radio Engineers (U.S.)
*[BIRE	British Institute of Radio Engineers
IREA]	Institution of Radio Engineers of Australia
Bell	Bell Telephone Co. publications
A.I.E.E.	American Institute of Electrical Engineers
Mfr.	Manufacturer's *periodical* (not shown elsewhere)
Nucl.	Nucleonics
El. Mfg.	Electrical Manufacturing
E.I.C.	Engineering Institute of Canada

**Note:* Sources bracketed are coded under the same hole.

Fig. 3. Using a sorting needle.



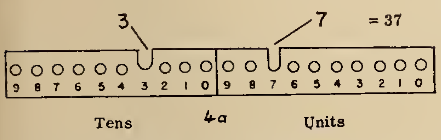
Subject Matter Classification

The remaining marginal space on the card, amounting to almost half the total, is devoted to subject classification. The main subject headings are assigned to the inner row of 24 holes of the subject field. (Should it be necessary, these 24 subjects can be increased to 48 by using holes 25 to 48). Each individual subject heading can be divided into 24, the divisions being punched in the outer row of holes of the subject field. In turn these 24 divisions are each subdivided, using the fields on the card left edge marked "subject subclassification."

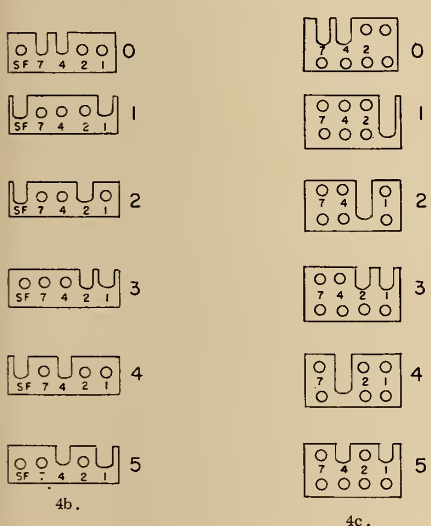
Lest it be felt that the growing subject index will eventually become unmanageable, it must hastily be stated that no effort need be made to remember the various headings of the growing index. The punched cards

Table I
Main Subject Headings

A — Antenna System	N —
B —	O —
C — Circuit Components	P — Power Supplies to Apparatus
D —	Q —
E —	R —
F —	S —
G — Wave Generating and Shaping	T — Tubes and Solid State Devices
H — Amplifiers	U —
I —	V —
J —	W — Historical and Biographical
K —	XYZ — Card Index System
L — Location and Aids (Radar)	
M —	



Direct punching. Two fields shown: 0 to 99 in twenty holes; one punch per digit.



Coded punching. Two punches per digit

Fig. 4. Three types of digital punching.

supply their own memory and instructions with little effort on the part of the user. How this is done will be explained later.

It is best initially to defer subject punching until a substantial number of cards have accumulated. These cards are then consulted to determine suitable subject headings. A partial description of the subject index will clarify its use. Assigned subjects to date in the inner row of 24 holes are shown in Table I.

To see how these subjects are divided, assume a sort is made, say through the seventh *inner* hole "G". The cards for "Wave Generating and Shaping Circuits" are thereby separated from the others. To date the divisions of this subject (outer 24 holes) are as shown in Table II.

"G" of Table I did not appear to fit any division in Table II, it is simply left unpunched in the division field. Such cards automatically form a "Miscellaneous" category, and ultimately they provide information for new headings for Table II. Admittedly these "miscellaneous" groups require a somewhat lengthy sort.

It occasionally happens that a reference relates to more than one subject division, in which case all relevant division holes are punched. Since, however, subsequent classification will usually be different for these different divisions, means must be provided to separate cards with multiple punching. The hole position marked "dup" (for duplicate) is therefore punched on cards with multiple subject-divisions to make possible

Table II. Divisions of Subject Heading "G"

A — R-C Sinusoidal Oscs. and others (except B or C)	L — Linear passive circuits (classical filters, etc.)
B — L-C Sinusoidal Oscs.	M — Multivibrators and blocking oscillators, triggers, relaxation oscillators.
C — Xtal controlled or stabilized Oscs.	N —
D — Diode detectors, clippers, clamps, d-c restorers, discriminators, mixers, converters, modulators, correlators.	O —
E —	P — Phantastron family (operational amplifiers) under Table, I, H.
F —	S — Scaling, dividing, and multiplying
G —	V — Specs. and standards
H —	W — Historical and Biographical
I —	XYZ — Card index system
J —	
K —	

If a sort is now made say through *outer* hole "M", we obtain the cards "Multivibrators and Blocking Oscillators, Triggers" as a division of the subject "Wave Generating and Shaping Circuits". If at the time a card is made, it does not fit any of the available categories, punching is discontinued at the point of difficulty. For example, if a card punched under their separation and subsequent correct sorting. It is not *necessary* to do multiple punching, and if it is omitted, no cards in the proper category will be missed. However, cards in related categories which might be useful will no longer appear. If the multiple punching is done, but the "dup" hole not sorted, no harm, other than the bypassing of cards in related categories, will occur. The odd stray card may appear here and there but can be ignored. Mulitple punching is equivalent to the "see also" headings, commonly used in cataloguing, with the advantage that only selected cards from the "see also" headings are dropped.

The subject divisions, such as the sample "Multivibrators and Blocking Oscillators, Triggers", are now further subdivided using the subclassification fields on the card left margin. The scheme used is the same as that for the subject field. The inner row of holes comprise the subject subdivisions, and these subdivisions in turn are each further divided using the outer row of holes. For this discussion the six fields are assumed numbered one to six, from left to

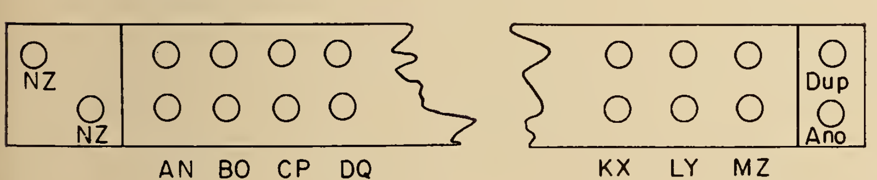
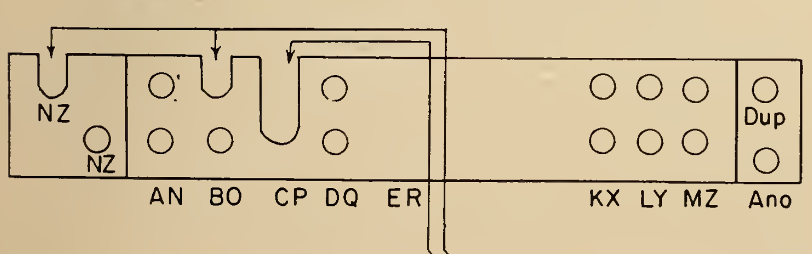


Fig. 5. (a) Author code (above). (b) Example: Copeland.



right (field six being thus the one on the same card edge as the main field). Subdivision is normally started at field five, hole 2, and proceeds left. Hole 1 of field five is reserved for the card index system. It is intended that field six be not used as are the other five. It is reserved; its inner row of holes could be used to subdivide any outer holes of the fields 1-5, and the outer row, as usual, to subdivide each inner hole topic further. We have not yet found it necessary to go this far. Hole NZ of field six again would be reserved for the functioning of the card index system, and not used in the subject breakdown. Summarizing, the scheme is this:

46 subjects	(Main field, inner row)
x 23 divisions	(Main field, outer row)
x 30 subdivisions	(Sub-Class. Fields 1–5 inner row)
x 30 branches	(Sub-Class. Fields 1–5 outer row)
x 5 sub-branches	(Field six, inner row)
x 5 final groups	(Field six, outer row).

There are thus about 20 million possible categories. Obviously, no one will use them all, but this large excess makes the scheme exceedingly flexible. It is even possible to abandon a scheme and start over with a new subject breakdown on a different part of the same card. The subdivision scheme shown is only one of many possibilities. A sample alternative would be to have on this edge two alphabetical fields (like the author field) which would allow four letters to be punched for word or title coding.

Now it is clear that such a large scheme cannot possibly be memorized. In fact even to prepare a skeleton outline of headings would be a formidable task. With punched cards neither is necessary. One of the outstanding features of the system is the facility with which a subject index can be prepared and consulted, with the cards alone as the only aid. The method of accomplishing this is described in the following paragraphs.

Operating Information and Instructions

The last hole position (XYZ) of the main subject field, like the last hole on a telephone dial, is reserved for information about the system. A sort through this position (inner XYZ hole) drops a card bearing a list of the main subject headings given in Table I. (Another card or two may drop, but ignore them for the moment). On the card also are the instructions for obtaining the list of the divisions of any subject on the card: "To obtain a list of the divisions of any subject (and their assigned holes) sort through the hole position of that subject, then through the outer XYZ hole position. On the card also will be found instructions for the next step."

Assuming that the procedure of the preceding paragraph has been followed, we now have a card with the list of subject divisions. The instructions on this card are as follows: "Sort through the subject division hole, then through inner hole 1 of field 5 of the sub-classification field to obtain the subdivision headings." The card obtained by following these instructions has, besides the subdivision headings (Table II), instructions for the next step. "Sort once through outer hole 1 of field 5 to obtain a list of the subdivision branches." This card again has instructions, and the process is repeated as above using inner and outer hole NZ of field 6 to obtain sub-branches, and ultimately, final group headings.

It is unlikely that the above scheme would be carried to completion for any subject. Normally, a stop is made at some intermediate point in the subject breakdown, the actual point depending on the number of cards in a category. Even some main subject headings may not be divided at all if interest (by that particular user) is limited.

To prevent confusion when several people share a file, it is wise to prepare a blank card for the next subject index step beyond that in use. Thus a person sorting for, say, the list of divisions of a main subject, when no division list had been prepared, would obtain a blank card to inform him of this fact. The blank card is later used for the list of divisions when it is eventually made. At that time also new blanks are prepared for each sub-division list (one blank per heading) to inform the user of this new terminal point. These blanks provide assurance that a sought-for list of category headings actually does not exist, and is not merely being overlooked through faulty sorting or through someone having removed it from the file for consultation.

Note that three (outer hole) sorts as follows: hole XYZ of subject field, hole 1 of field 5 and hole NZ of field 6 of the subclass field, will drop all cards relating to the subject index.

When the information hole (inner XYZ) was sorted and the list of main subject headings obtained, it was stated that a few other cards might also drop. One of these cards gives the list of coded sources, if one is used. This card was mentioned earlier in the description of the source field punching. It has the "coded source" position punched in addition to inner XYZ. Thus the "information" position serves both subject and source fields. It is also used when any of the "extra" holes X2, X3, X6, X7, X8 are used, the "extra" hole and the "information" hole being punched on a card which carries an explanation of the function. The information position is also used where anomalies in the system need explanation. As an example, one such card of ours explains that the coded source number 45 is not to be used. The reason is that 4 and 5 ("U.S. Military" and "University" sources, respectively) are *both* punched on many cards because they refer to work done at a University, but supported by the U.S. Military, and normally reports are available through Military channels. The anomaly of two sources results in double punching (4 and 5) which could be confused with a coded source (45) if used. As a matter of fact, it is always wise to sort a proposed punching code before adopting it, as the unexpected dropping of some cards will indicate it is already in use, if perhaps unknowingly.

Conclusion

The system described is not a panacea but, properly used, it can be a very great help. Some thought and care are necessary. The classifying of information is difficult. The equipment described will not do it for us, but it will facilitate the use of information that has been well classified. Its use should also give an understanding of the capabilities and limitations of the large machine-operated card systems which now are entering our everyday life. The cards shown in Figs. 1 and 2 are made by the McBee Co. and Copeland-Chatterson Ltd., respectively.

Reference

1. Punched Cards, R. S. Casey and J. W. Perry, (Book) Reinhold Publishing Corp., N.Y. 18, 1951

Economics of Pumped Storage

C. Jaeger

Consulting Engineer, The English Electric Company Limited, England

Condensation of a paper read at the 72nd Annual General and Professional Meeting of the Engineering Institute of Canada, Quebec City, May 1958

IN RECENT YEARS, renewed attention has been given to pumped storage and the eeonomics of eombined methods of power production together with pumping.

The analysis of this problem of economies can be dealt with from two different angles.

A. From the angle of general power requirements and demand: This leads to a mathematieal analysis of power systems whieh is the subjeet of a paper submitted to the Engineering Institute of Canada.

B. From the angle of actual power produetion. The best approach would be a systematic study of existing designs of pumped storage.

A. Economics of Pumped Storage from the Angle of Power Demand

This investigation on the economies of pumped storage started eonsidering an eleetrie system similar to the British system, which is rather compaet, and where addition of nuclear power is an urgent problem. The Canadian system, extending over immense areas, with still considerable hydro power potential in reserve and the possibility of additional seasonal and yearly storage of water, offers eonditions which are at the opposite of what the British system is to-day.

Can a method devised to analyse eonditions in the former system be adapted to eonditions in the latter?

The answer must lie in the method itself.

The paper deals with the economics of combined methods of power production and pumped storage, with a mathematical analysis of power systems. The full text will appear in *Water Power* (England) vol. 10, no. 6, 7, 8, 1958.

Planning of new sourees of eleetric energy is based on extrapolating the load demand eurves many years ahead.

Any suitable method of investigation must tend to reduee the number of free parameters to a minimum. The method submitted here is entirely based on the analysis of the load factors of the system and its eomponents.

It can also be shown that the balanee sheet of power and energy production by a group of stations depends entirely on these load factors too, as do the prices and eosts.

The system load faetor is a quantity which varies slowly with time and its trend ean be predicted several years ahead. A method of priee analysis entirely based on these load factors makes economie predietions fairly reliable and the method ean be adapted to a wide range of alternative eases.

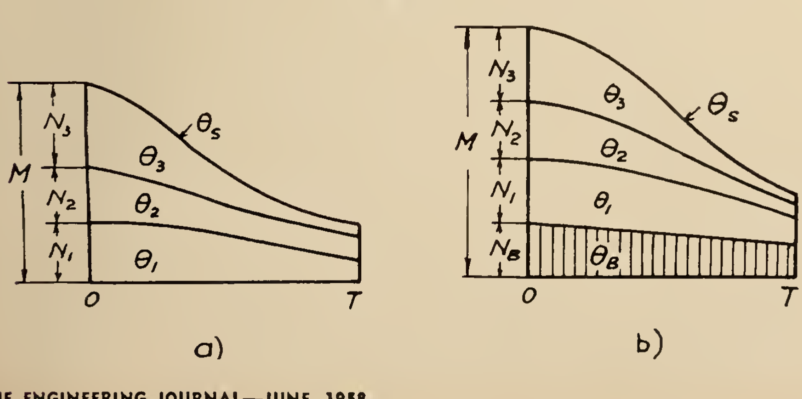
Let us look into the details of this method of analysis:

Any electric power system with a total installed eapacity M and a system load faetor θ_s can be broken down into system eomponents characterized by their installed eapacity $N_1, N_2 \ldots N_i \ldots$ and their load factors $\theta_1, \theta_2 \ldots \theta_i$ taken over a period T. (Fig. 1.)

The following general theorems can be demonstrated*

1. There is a linear relation between θ_s and $\theta_1, \theta_2 \ldots \theta_i \ldots$ depending only on $N_1/M \ldots N_2/M \ldots N_i/M$. This linear relation does not depend on the shape of the duration eurve derived from the load/time eurves of the system. (Fig. 2, below.)

Fig. 1.



Basic equations

$$\theta_s M = \theta_1 N_1 + \theta_2 N_2 + \ldots + \theta_i N_i + \ldots$$

$$\theta_s (M + N_m) = \theta_1 N_1 + \theta_2 N_2 + \ldots + \theta_i N_i + \ldots + \theta_m N_m$$

Condition of no change in existing system $\theta_s M$ is:

$$\theta_m = \theta_s$$

Condition for change of load factor θ_i to $\theta_i' = \theta_i + \Delta\theta_i$

$$\theta_m = \theta_s - \frac{N_i}{N_m} \Delta\theta_i$$

*These theorems are demonstrated at full length in the original manuscript submitted to the E.I.C. and to be published in June, July, August by "Water Power", London.

2. Any new source of power with capacity N_m and load factor θ_m added to an existing system $(M\theta_s)$ may change the load conditions in the system components $(N_i\theta_i)$. The condition for no change to occur in the existing system is $\theta_m = \theta_s$.

In the more general case

$$\theta_m = \theta_s - \frac{N_i}{N_m}\Delta\theta_i$$

where $\Delta\theta_i$ is the change occurring in the system $(N_i\theta_i)$ owing to the addition of a new source of energy $(N_m\theta_m)$. This fundamental relation will allow us to relate the price analysis of the new system to price changes occurring in the component "i".

3. More detailed investigations, especially investigations concerning pumped storage, require the exact knowledge of the true duration curve of the system. For the sake of theoretical system analysis, the true duration curve can be replaced by a convenient mathematical curve which can be integrated.

The choice was for the so called Soschinski function, which is found to match actual duration curves in a great number of cases, particularly those for large systems. This function shows the load N at the time t $(0 < t < T)$ to depend only on θ and $\theta_0 = m/M$ where

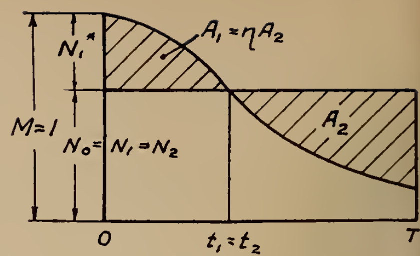


Fig. 4.

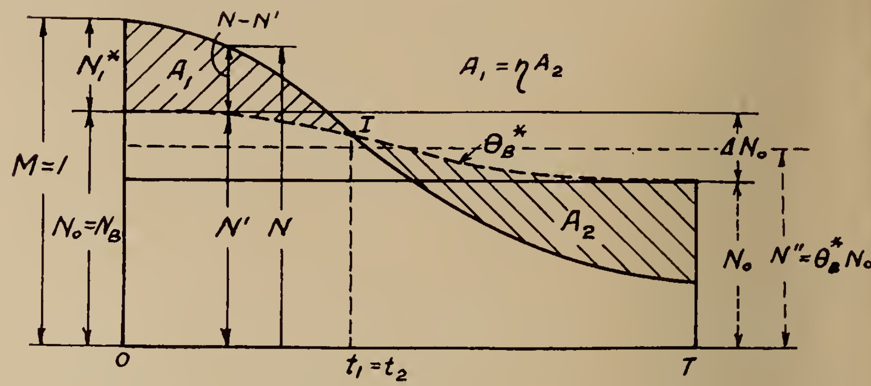
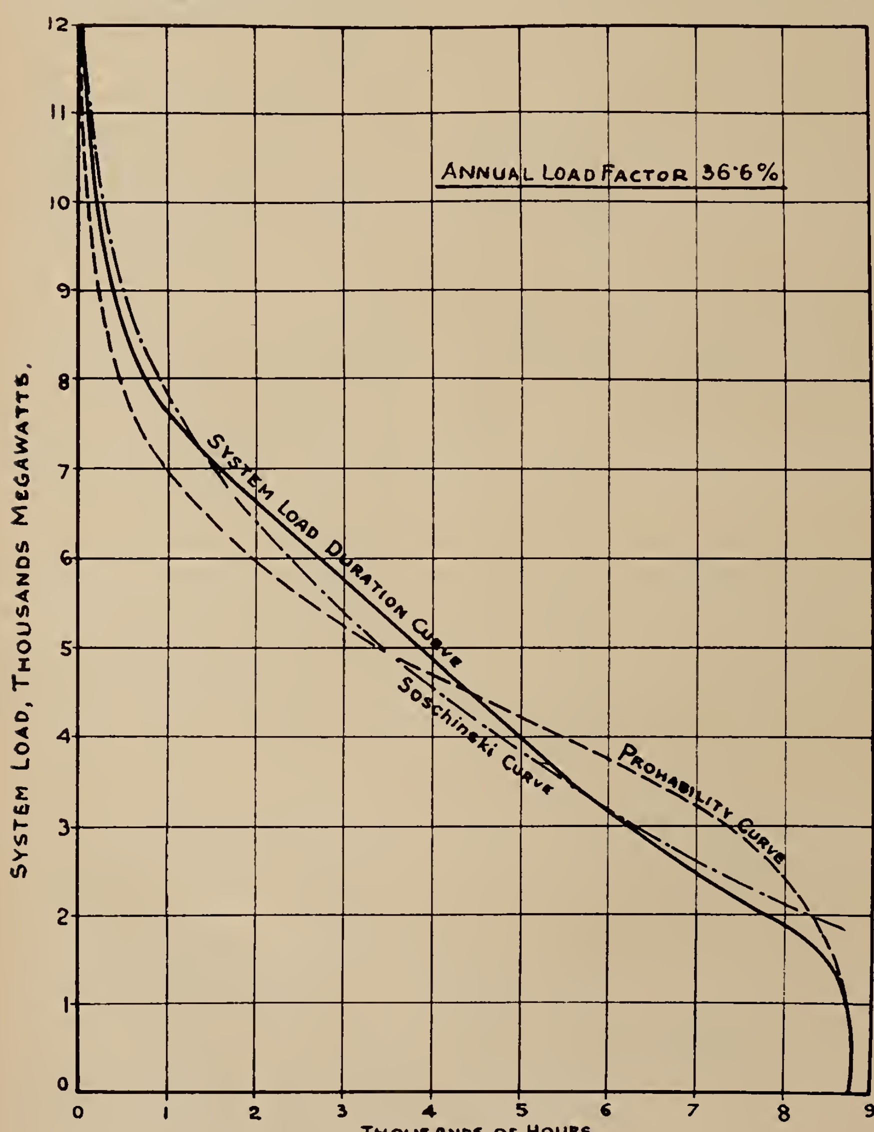


Fig. 5.

Fig. 3. 1957 load duration curve for England areas.



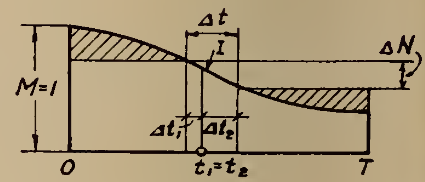


Fig. 6.

M is the maximum (installed) capacity; m the minimum required load. (Fig. 3.)

The Soschinski function is

$$N = M[1 - (1 - \theta_0)t^{(\theta-\theta_0)/(1-\theta)}]$$

Both θ and θ_0 can be predicted from a number of real load duration curves.

The basic problem for which the Soschinski curve will be used is to find out the best possible utilization of a given pumped storage or the theoretically best design and suitable capacity for a pumped storage to match a given base load station. If A_2 is the energy required by the pumps and A_1 the energy generated by the generating sets in the pumping scheme, then $A_1 = \eta A_2$ where η is the overall efficiency of the pumping scheme including transmission losses. (Fig. 4.)

The basic problem corresponds to an ideal case of full utilization of the base load $(\theta_B = 1)$. For practical purposes the following additional research will be required:

Comparative estimates will be carried out for a base load characterized by $\theta_B = 1$ and by $\theta_B < 1$. (Fig. 5.)

When there is a time lag Δt between

Basic equations

Soschinski Curve

$$N = M\left[1-(1-\theta_0)t^{\frac{\theta-\theta_0}{1-\theta}}\right]$$

Energy equation for pumping:

$$A_1 = \eta A_2$$

Effect of time gap Δt: $\Delta N = \left(\frac{dN}{dt}\right)_{t_0}\Delta t$; $\Delta E = \Delta N . T$

Variation of efficiency: $\Delta N_2 = \Delta N_1 + \frac{\eta_1 - \eta_2}{T} A_2$; $\Delta\Delta A = (\Delta N_2 - \Delta N_1)T$

Price equation

$$k = nN + mE$$

Fig. 7.

the stopping of the pumping and the beginning of generation, there is a loss of power ΔN and energy ΔE given by

$$\Delta N = \left(\frac{dN}{dt}\right)_{t_0} \Delta t, \quad \Delta E = T \,.\, \Delta N$$

(Fig. 6, 7.)

The overall efficiency of a system combining pumping and generating depends widely on the transmission distance between the primary base load station and the pumping station. When two alternatives corresponding to efficiency factors η_1 and η_2 have to be compared, the loss of power for both alternatives is given by

$$\Delta N_2 = \Delta N_1 + \frac{\eta_1 - \eta_2}{T} A_2$$

4. A detailed balance sheet has to be established for all energies generated, transformed and lost. (Fig. 8.)

It can be shown that such a balance sheet can be traced graphically and that the only variables to be considered are θ (the load factor of the demand curve), θ_B (the load factor of the base load station) and the overall efficiency η for pumping.

5. Most of the problems of cost and prices can be represented by fairly simple mathematical functions. So can the problem of the price of electrical energy, which is of the form

$$k = nN + mE$$

where N = installed capacity; E generated energy, n and m constant factors which can be shown to depend mainly on θ.

Summarizing this, it can be shown how the whole problem of costs and prices—analysed from the point of view of the demand for more power—depends mainly on the load factor analysis, the main free parameters being θ_s the system load factor and θ_B the base load factor.

Figure 9, referring to hydro power combined with pumped storage, is most instructive: k_w is the price of 1 kwh. produced in a hydro power plant working alone (capacity N_w); k_p is the price of 1 kwh. of energy generated in the pumping plant with capacity N_p and k_{w+p} is the cost of the unit energy generated in a combined system of water power supplemented with pumped storage. The system load factor θ_s is the main variable and the ratio k_p/k_w the main free parameter. The condition $k_{w+p} \leq k_w$ for the combined system to be economical is obtained for a wide range of values k_p/k_w as shown on this Fig. 9. It is possible with such a diagram to estimate a limit for which the

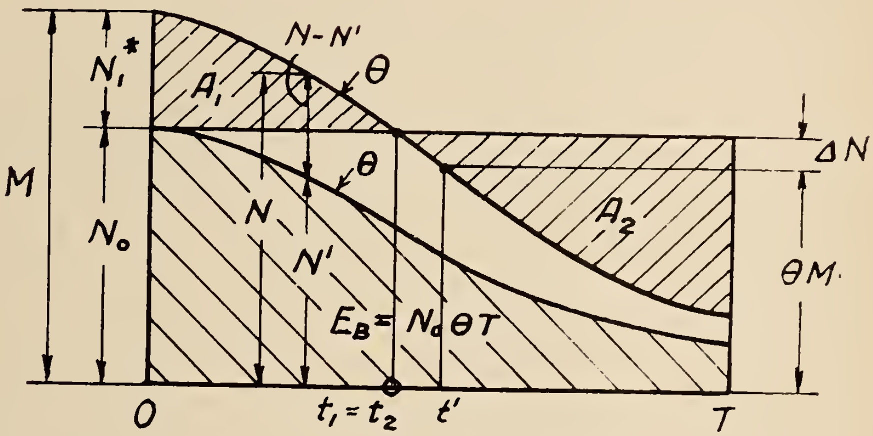
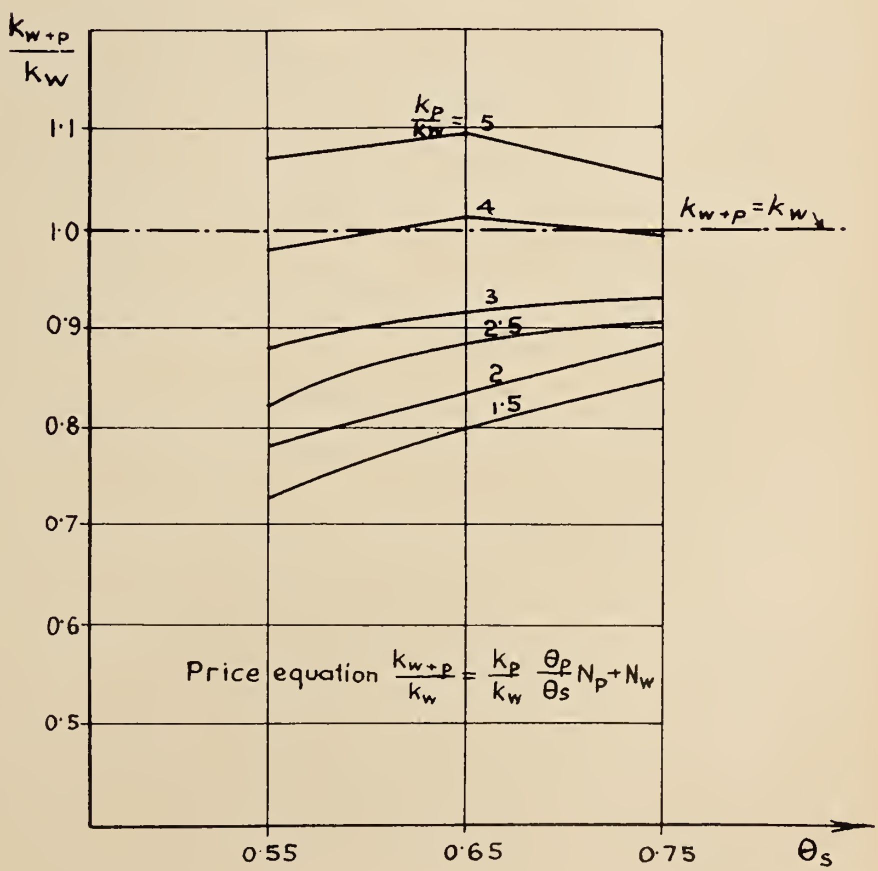


Fig. 8. (above). Fig. 9. (below).



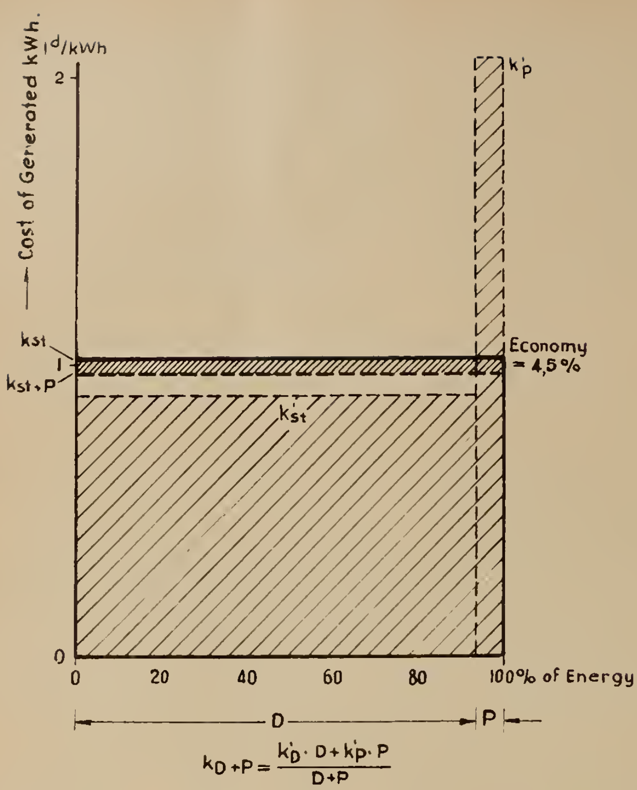


Fig. 10. Compared cost of power generation for steam and for steam plus pumped energy.

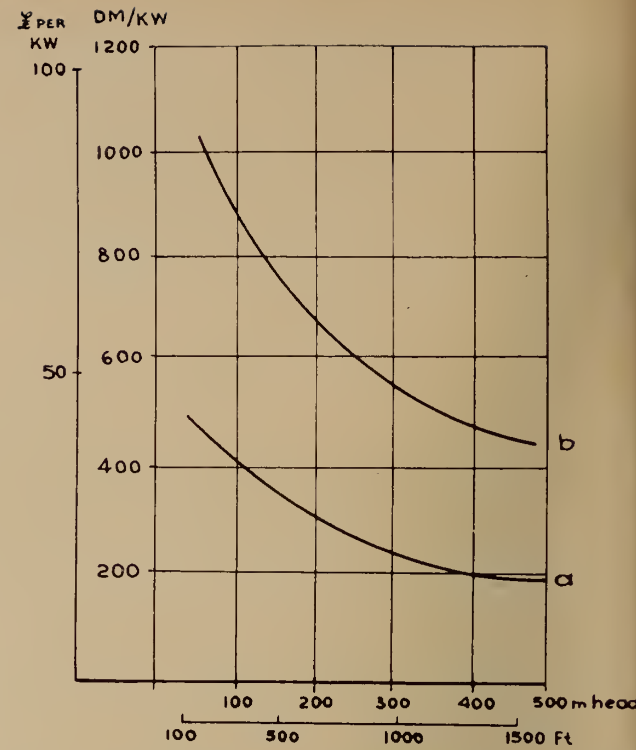


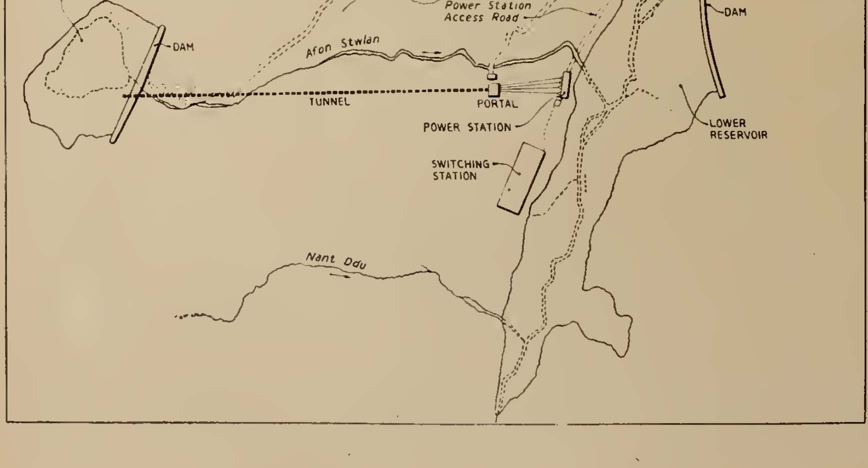
Fig. 11. Cost of German pumped storage stations in DM. or £ per kw. for head from 100 to 1500 ft. (a) Costs in 1926-1930; (b) costs in 1956 average.

ratio of costs per kw. or prices per kwh. is in favour of hydro alone or of combined hydro power and pumped storage.

An equivalent diagram is easy to trace for combined nuclear power and pumped storage. Both diagrams show that it is economical to add large pumping stations to a system basically fed by run-of-river stations or by nuclear power. Substantial savings are possible, up to 20 per cent. on the price of the kwh. generated.*

The combination of steam power and pumped storage leads to more intricate calculations, because the cost of coal must be included as a main variable of the problem. The diagram Fig. 10, above, of the Energie Versorgung Ost Bayern in Bavaria shows such a combination to be economical. But data from other countries (U.S.A.) show that this combination is often a marginal case. For practical purposes a combination of run-of-river power, thermal energy, and pumped storage will often have to be considered.

Fig. 12. Sketch map of the Ffestiniog scheme in North Wales (according to V. G. Newman, BEAMA Journal).



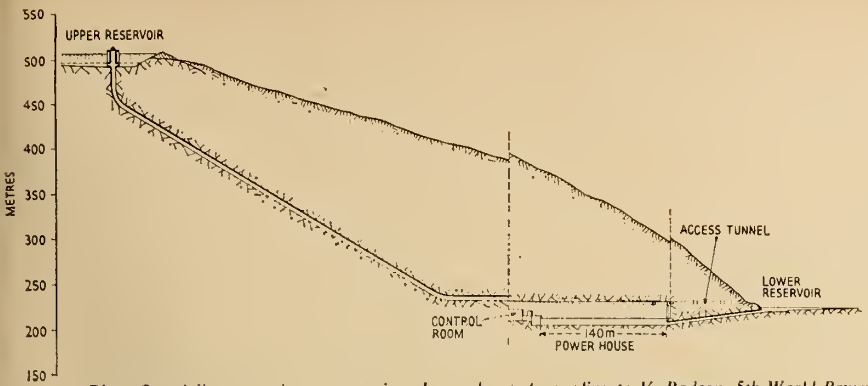
B. Research for Suitable Practical Solutions (from the Production Angle)

The second point to be discussed concerns practical pumped storage designs which can be commended as being economical proposals. The best approach is to review typical schemes and to comment on them from the angle of their economical advantages.

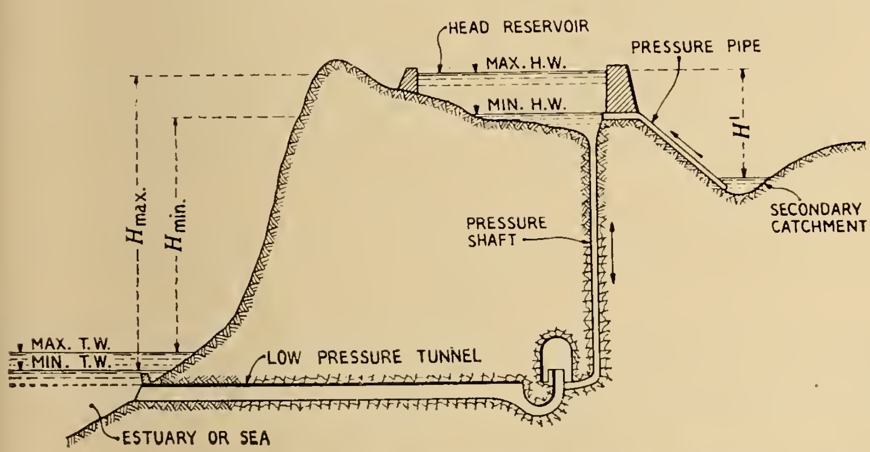
1. *Pure and Mixed Pumped Storage*

Pumped storage is said to be pure pumped storage when the total discharge and the head are the same for the pumps and the turbines, or mixed pumped storage when there is more water passing through the turbines than through the pumps and/or when the head available for power generation is

*Full details will be given in the August issue of "Water Power".



River Our daily pumped-storage station, Luxembourg (according to V. Bodson, 5th World Power Conference)



greater than the head against which the pumps have to work. Typical example of the first arrangement are *Ffestiniog* (300,000 kw.) (Fig. 12) in Wales or *Our* (320,000 kw.) in Luxemburg (Fig. 13).

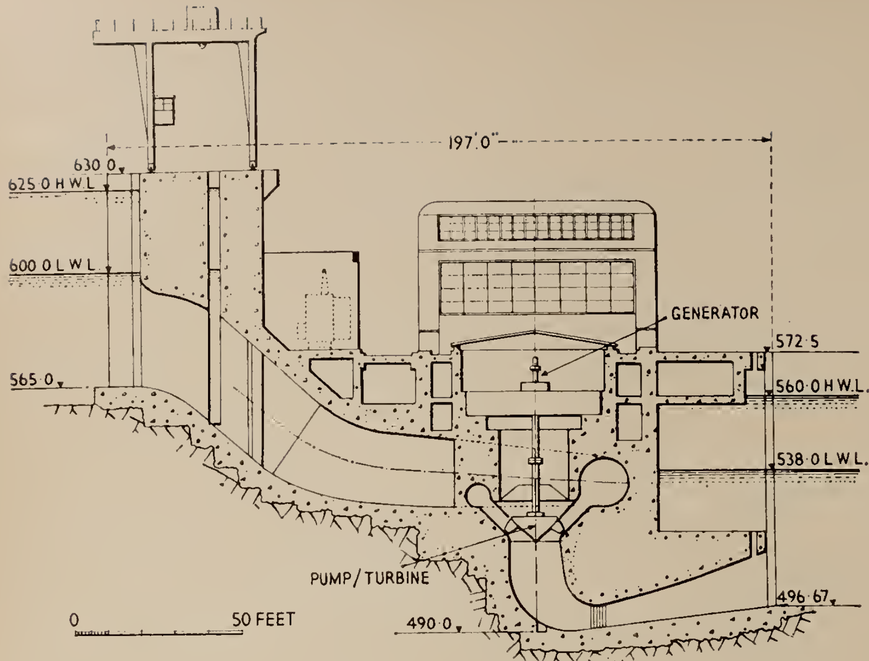
The first station uses conventional pressure tunnel, surge tank and pipe lines, the second, built in the centre of the West-European coal industry, is underground with an inclined shaft. It has also been suggested to use cliffs near the sea for installing pumping stations of this type (Fig. 14). The Sir Adam Beck Niagara pumping station in Ontario (20,700 kw.) is a well-known example of conditions where the total head available for power generation is larger than the pumping head. (Fig. 15 and 16.)

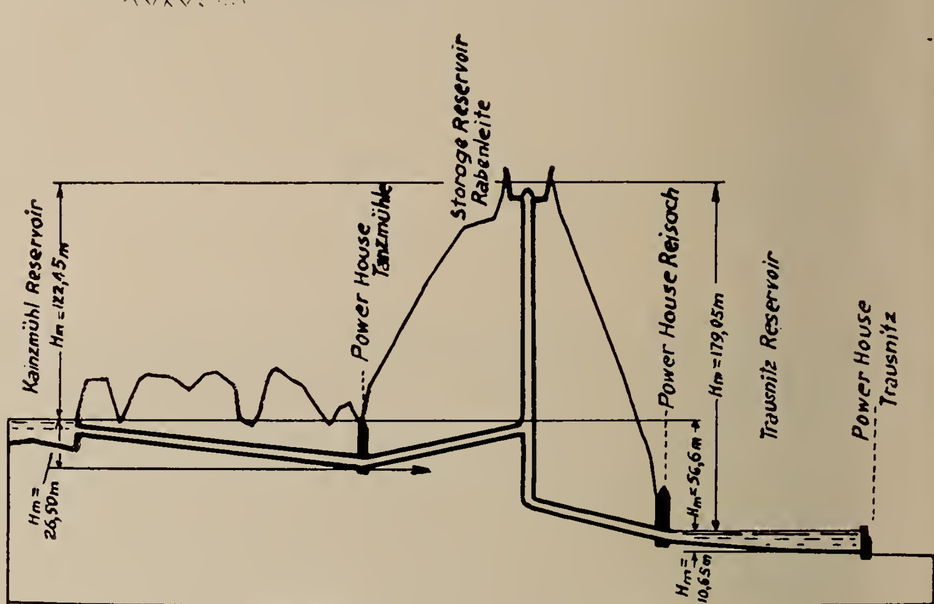
Reisach in Bavaria is a more complicated design: there are two low level reservoirs with two stations equipped with pumps and turbines but only one common high level storage reservoir. By skilfully combining these three reservoirs it is possible either to produce a maximum of kwh. or to have the highest possible capacity in kw. (Fig. 17.)

Fig. 13 (top left).

Fig. 14 (left).

Fig. 15 (below). An aerial view of the Sir Adam Beck-Niagara generating stations (E, F) with the reservoir for pumped storage (L).





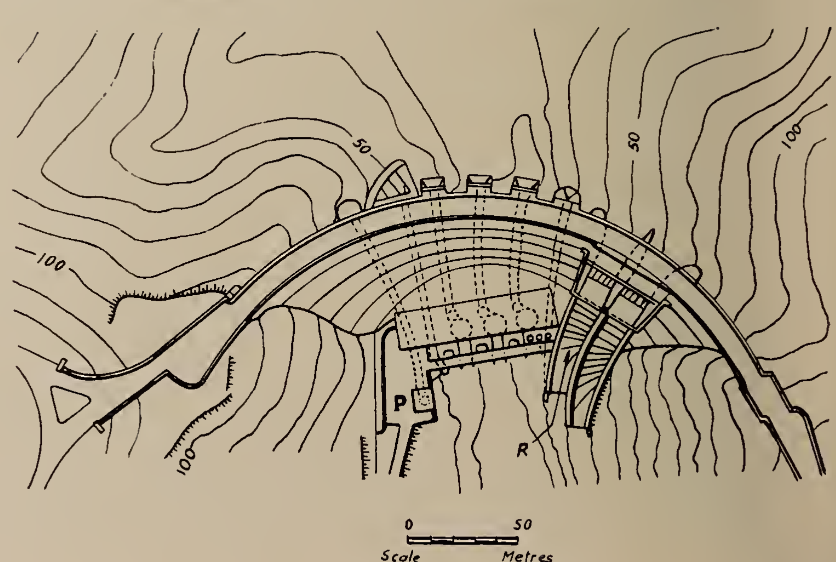


Fig. 16 (top). Section through the Niagara pumped-storage station showing the extremely compact layout obtained with a reversible Dériaz pump-turbine.

Fig. 17. Reisach pumping scheme (Bavaria).

Fig. 19. (below, r.). Diagram of English Electric Company arrangement to improve an existing low head scheme. (Fig. 18 is on p. 73.)

2. *Effect of Head on Price of Pumped Storage*

Another remark concerns the total head of a pumping station. Comparative price studies based on German pumping stations show the price per installed kw. to decrease with the pumping head. This is easy to visualize. (Fig. 11.)

3. *Availability of Excess Energy*

An even more striking difference exists between daily storage, weekly storage and yearly storage, with rapidly increasing unit prices when passing from one type to the next. This last problem is linked with the availability of excess power. In the past the market analysis for excess power has received possibly too little attention. From the point of view of pumped storage economics it is of great importance. Cheap generation of pumped energy is possible only if excess power is available in convenient quantities for convenient periods of time. In favourable cases, daily or weekly storage may be possible. If not, yearly storage may have to be considered which is a quite different proposal.

(*a*) *Cheap night power always available.* Let us suppose a base load nuclear station running at a very high load factor θ_B. Excess power will be available every night, all over the year, and combination with a daily or weekly storage is attractive. It can be shown to be economical and the economy on the generation of 1 kwh. can be as much as 20 per cent. or more.

It is estimated that in Canada nuclear energy compared with conventional steam energy may become economical about the year 1980. If pumped storage is considered in combination with the production of base load, then the point of equal production costs may come several years earlier.

Another most interesting solution concerns the case of a large run-of-river station capable of producing constant yearly power. The station may be assumed to be located at a great distance from the centre of load consumption. Only base load is to be transmitted over such a distance. A pumped storage scheme located near this centre produces the corresponding daily peak load and considerably improves the conditions for overall cheap power production. Such conditions are likely to occur in Canada, where vast resources of potential energy are available in the far north of the country.

In both cases mentioned, the basic fact is that cheap constant base load power is available over long periods when the pumps can work to make daily generation possible at a convenient load factor.

(*b*) *Excess night power available only over limited periods.* The opposite example concerns run-of-river plants where excess power is abundant during the rainy period but scarce during the dry season. Such conditions are characteristic of the European Alps: power is scarce when most required and yearly storage has to be considered. *Wäggital* and *Etzel* in Switzerland are well-known examples of yearly storage, where additional pumping of water during the wet season is used to fill existing conventional water power reservoirs for generation during the dry season. The two schemes are mixed pumping schemes, and the large reservoirs were first built for conventional production of hydro-power only.

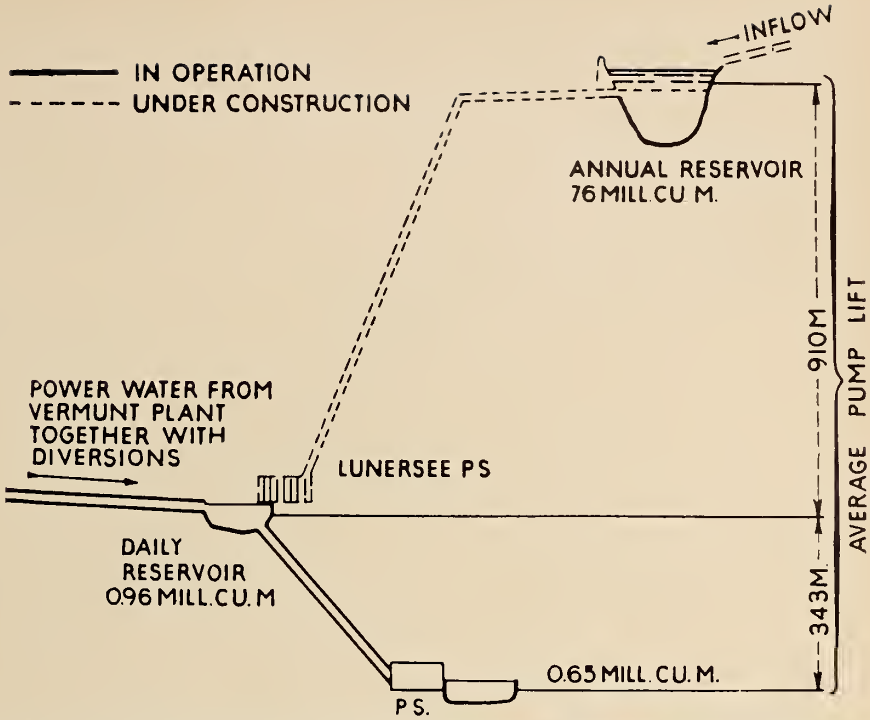
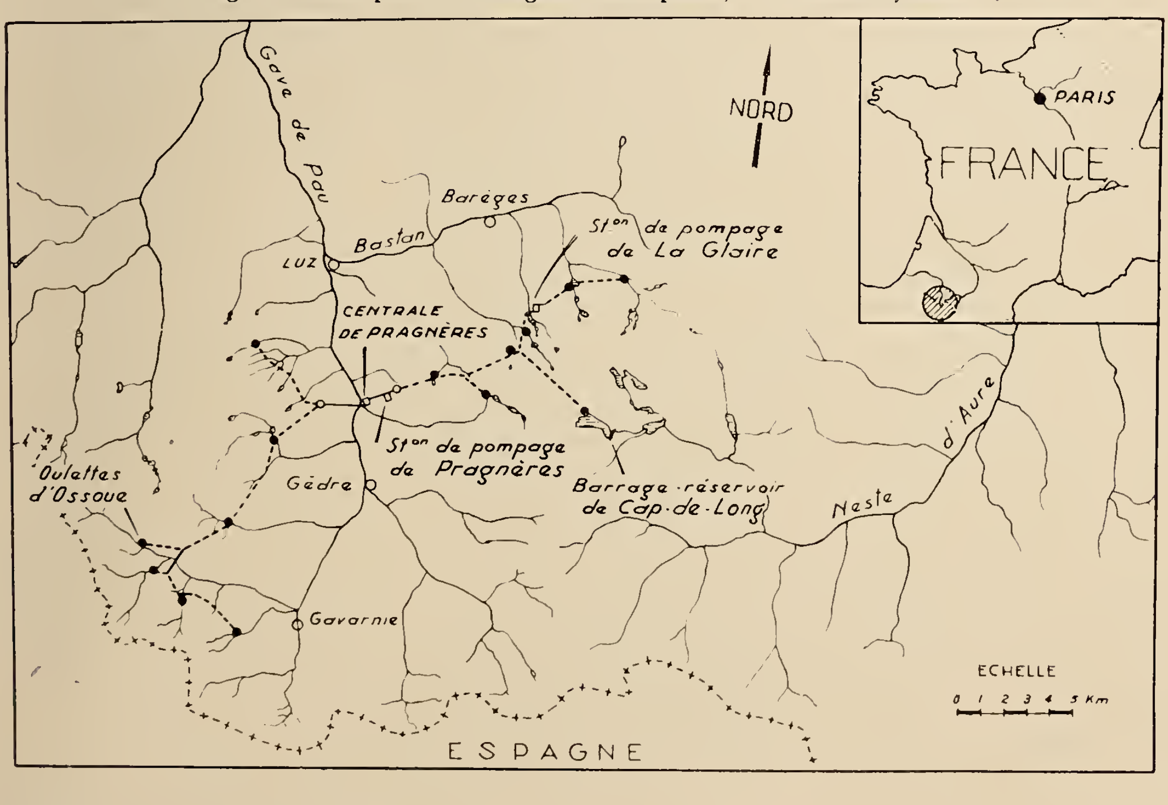


Fig. 18. The Rodund and the Lünersee pumped-storage schemes of the Vorarlberger Illwerke (according to A. Ammann, 5th World Power Conference).

An alternative solution to this arrangement is shown by the *Illwerke* in Austria, where a daily storage (170,000 kw.) and a yearly storage reservoir (217,000 kw.), with its own catchment area, are used simultaneously. The

Fig. 20. General plan of the Pragnères development, in the French Pyrenees.



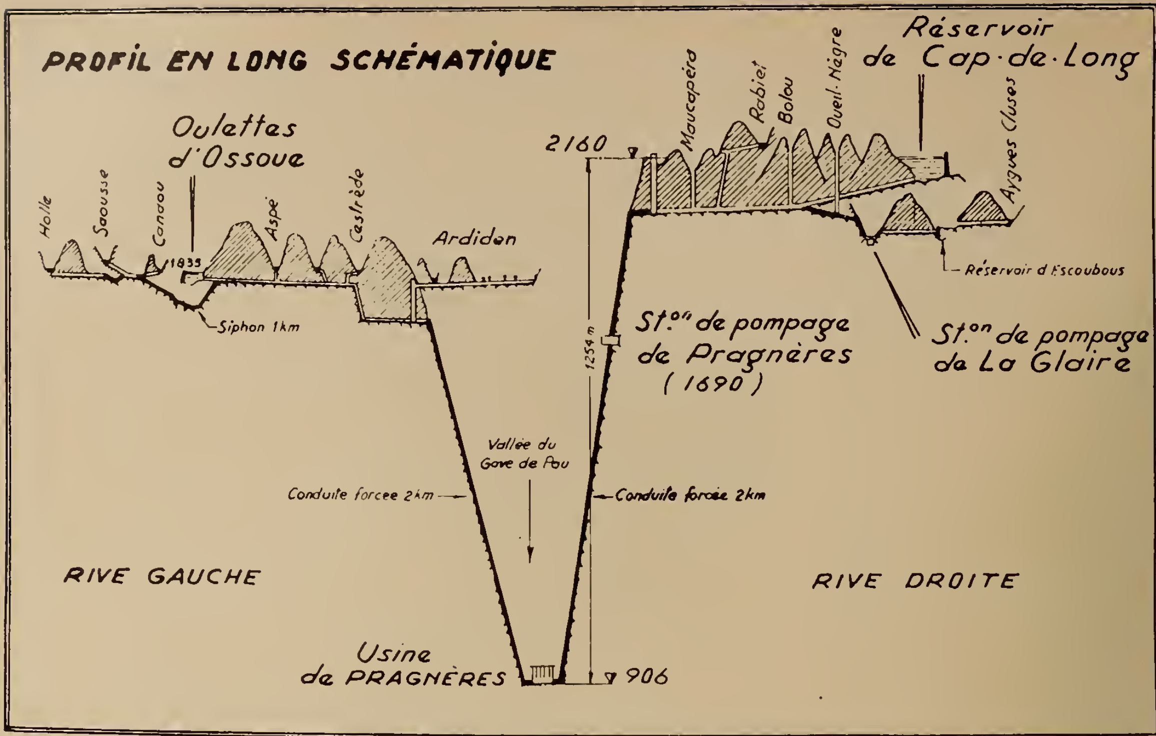


Fig. 21. Schematic profile of the Pragnères development.

Illwerke are designed to be the main regulator for power generation and frequency regulation on the central European system. (Fig. 18.)

4. *Extension of Existing Conventional Hydro Power Schemes*

Reverting to mixed storage schemes, the introduction of pumped storage to existing conventional hydro-power schemes may be a rewarding solution.

The diagram Fig. 19 shows an arrangement the English Electric Company submitted to one of their customers to improve an existing low head scheme. The existing plant is equipped with three Francis turbines. An additional Dériaz pump-turbine "P" could be added. Pumping water during the night, whenever excess power is available in the system, increases the available peak load during the next day. It also maintains high water levels in the reservoir over a longer period, compared with conventional running conditions and improves conditions for power generation during the dry period.

Enlarging existing high head schemes by adding a pumping set is another solution worth considering. To some extent it may be possible to extend the scheme without increasing the physical dimensions of the existing dam, tunnel and galleries or shafts. It has been shown that there is a limit to such improvements, owing to additional friction losses in the conduits.**

Far larger extensions of existing schemes may be considered. The extension scheme for the *Loch Sloy* hydro-power station near the city of Glasgow in central Scotland forsees a series of entirely new powerful pumping-generating stations, located underground, added to the existing conventional hydro-power station. The existing dam would be the only item not to be duplicated for the pumping station, which capacity (up to 1 or 2,000,000 h.p.) would by far exceed the capacity of the existing hydro-power station (200,000 h.p.). The capital cost for the new pumping capacity would include only the galleries and shafts and the machinery. Base load power would be mainly excess nuclear power generated during the night.

5. *Pumping Used to Increase the Potential Energy of Stored Water* (Fig. 20, 21.)

The last example to be referred to is the *Pragnère* development in the French Pyrenees: water is pumped up 325 m. into a reservoir and is then used for generation with a total head of 1,254 m. The economics of such a system, of which there are many examples in the Alps, is based on the increase of potential energy.

References

1. L. Musil. Praktische Energiewirtschaftslehre. Vienna, 1949.
2. Ch. Jaeger. The economics of pumped storage. Water Power, v.9, n. 2 and 3, Feb./March 1957.
3. Ch. Jaeger. The correlation of nuclear, thermal, and pumped storage capacity. Water Power. v.10, n. 6, 7, 8, June/July/Aug. 1958.
4. B. Jansen and K. H. Haager. Das Pumpspeicherwerk Reisach-Rabenleite. Energieversorgung Ostbayern, Regensburg, 1957.
5. M. Braikevitch. Some British developments in large plants for hydro-electric power generation. 5th World Power Conference, Vienna, 1956, paper 224H/37.
6. A. Ammann. Die Vorarlberger Illwerke. 5th World Power Conference, Vienna, 1956, paper 115H/23.
7. Guthrie Brown and contributors. Hydro Electric Engineering Practice, v. I, II, III, Glasgow, 1958.

**This particular problem has been dealt with in a previous paper published in "Water Power", London, February/March, 1957.

DISCUSSION

Discussion of technical papers and other articles in *The Engineering Journal* is welcomed.

Written contributions should be sent to the Editor, at 2050 Mansfield Street, Montreal 2, Que.

INTERNATIONAL NEWS

Research in Switzerland

COMMUNICATIONS from Dr. Edward Fueter, of Zurich, describe the organization and progress of nuclear research, and the work of the industrial research centres in Switzerland.

Nuclear Research

With a long tradition of scientific research, Switzerland has advanced considerably in the field of nuclear studies. Professor Albert Einstein, a citizen of Zurich in 1910, here developed his theory of relativity. In the 1930's a huge magnet was installed on the Jungfraujoch at the International Scientific Station, where studies of cosmic rays are made at a height of nearly 10,000 feet. Professor Wolfgang Pauli, Nobel Prizewinner for Physics, established the Pauli principle of exclusion from his work at the Federal Institute of Technology, Zurich.

Professor Paul Scherrer, of the same Institute, built one of the first cyclotron and cascade generators for laboratory use, and became the first president, in 1946, of the Swiss Committee for the Study of Atomic Energy. In each of the seven Swiss universities work has proceeded on the new science. Contributions have been made to the theory of mesons, and work has been done at Neuchâtel on applying atomic physics in the watchmaking industry.

Industrial developments include the world's first prototype of a Betatron (an induction accelerator) capable of producing 31 million electron-volts for therapeutic use, installed in 1951 at the Cantonal Hospital at Zurich, followed by further such installations in Europe.

In 1956 a Swiss firm produced a nuclear-energy/gas-turbine combination for small and medium sized power stations, and at the end of 1956 a group of industrialists offered to supply 'ready for use' nuclear power plants of various sizes.

Switzerland is admittedly behind the leaders in nuclear energy applications, but looks forward to developing a flourishing export industry of instruments and machines for the exploitation of nuclear energy. Laboratories must be created, staffs trained, and finances found. The Federal Government has drawn up a general program, headed by Director O. Zipfel, by which nuclear power stations in Switzerland should produce about 6,000 million kw. annually by 1975. This will provide the necessary power after harnessing all available hydraulic resources. The experience gained will be channelled to helping other countries.

Projects costing about 100- to 200-million Swiss francs are being prepared for the next five years. An organization 'L'énergie nucléaire' will concentrate the efforts of the four French-speaking universities and of Ecole Polytechnique, at Lausanne, to build a powerful reactor.

At Meyrin, near Geneva, a European Nuclear Physical Laboratory is being built by the Conseil Européen de la Reserche Nucléaire (CERN), at a cost of 220 million Swiss francs (about $50 million). This is the result of the united efforts of 12 European countries: Belgium, Denmark, France, the German Federal Republic, Great Britain, Greece, Italy, Yugoslavia, Norway, the Netherlands, Sweden, and Switzerland. Two-thirds of the cost will be borne by France, Great Britain, and Western Germany. Non-European scientists will also be admitted, and the Ford Foundation has recently made a donation of $400,000 for this purpose. A 600 Mev. synchro-cyclotron has been built, and a 920-ft. diameter proton-synchroton will be ready by 1960.

The CERN Institute has had help from the work of international teams of scientists working at the Alpine Research Station, where fundamentally important discoveries of the disintegration of mesons disclose a new chain of relations between the smallest elementary particles.

The proceedings of a 1956 meeting sponsored by CERN include such considerations as the acceleration of protons up to 1.25 x 10^{13} electron-volts at the plasma stage, in a circuit of about 10 ft. using magnetic fields of the order of 10^6 Gauss.

To build expensive installations, including reactors now under development, and to expand its activities, Switzerland has the assistance of the United States, as covered by an agreement made in 1956, which will assure the supply of concentrated uranium ore and supplementary materials, while respecting the independence and neutrality of Switzerland. Recently another agreement was concluded with France for collaboration in the field of nuclear energy and exchange of experience and personnel.

Work is now under way to amend the Federal Constitution and to authorize the Confederation to pass legislation for the protection of the public and for the prevention of accidents due to radioactivity.

The second international conference on the peaceful uses of atomic energy will be held in Geneva, 1-14 September, 1958.

Literature

A list of publications dealing with nuclear energy developments in Switzerland may be obtained from the Editor of the *Journal.*

Industrial Research Centres

As in all highly industrialized countries, research centres of private enterprise in Switzerland have assumed great importance in the 20th century. Together with the laboratories and testing plants of the universities and public institutions, they are an important factor in the competition for international markets.

Since the economic crisis of the 'thirties, private research centres have developed rapidly. From small staffs of a few scientists at the turn of the century, large enterprises may now permanently employ a hundred or more scientists or engineers. This is particularly so in chemical and engineering industries. One Swiss combine producing pharmaceuticals, dyestuffs, and synthetic materials spent 19 million francs on research in 1947 and 36 millions in 1955; corresponding turnovers were 478 and 783 millions. This expenditure of about 5 per cent is in line with allocations made in other countries. In some pharmaceutical and engineering firms the percentage is higher.

Facilities naturally vary, but one mechanical and electrical engineering organization has high-tension laboratories, a high-power testing plant, an electrical apparatus laboratory, a testing plant for lightning arrestors, testing plants for steam turbines, laboratories for combustion and flow research, three separate centrifugally stable remote-controlled testing beds for horizontal-axis machines, and so on.

In general, basic research is the concern of the scientific institutions, and applied research and development that of industry.

In addition to libraries for use by individual companies, some facilities are available to a wider field; for example, the Iron Library of Messrs. Georg Fischer, at Schaffhausen, and the Drug Collection of Messrs. Siegfried & Co., at Zofingen.

Only recently has contract research become commonplace in Switzerland. Substantial orders have been placed with the Federal Institute of Technology, particularly with the department for industrial research, and with such annexes as the 'International Division' of the Batelle Institute, in Geneva. In principle, however, Swiss industrialists tend to finance and carry out their own applied research, though they have made several generous contributions towards basic research at universities.

To make industrial research financially self-supporting, licence agreements are often made, which transfer results of research, patents, and inventions to foreign undertakings. This 'intellectual export' is considered a necessary and logical way of keeping self-supporting a country which is notably short of raw materials.

Branches of industry which have modern research laboratories have steadily increased their exports for at least a decade, underlining the importance of industrial research. However, overall success is based on the interaction of many factors, and without an excellent standard in general and technical education there would be no trained recruits for industry. A will to work, an ordered State, a sense of responsibility in leading personalities, and a pioneering spirit are all essential to the organization of the full value of industrial research centres and the justification of the large sums of money invested in them.

NOTED SWISS SCIENTIST

Tribute was paid to Prof. Jakob Ackeret, professor for aerodynamics at the Federal Institute of Technology (ETH), on the occasion of his 60th birthday in March 1958.

At Prof. Dr. Ludwig Prandtl's Aerodynamic Experimental Institute, in Göttingen, Germany, he wrote treatises on aerodynamic conditions on rotating cylinders (the Flettner rotor, used for the propulsion of ships) and other subjects. Returning to Switzerland in 1927, Prof. Ackeret extended and modernized the fluid dynamics laboratory of Escher Wyss Ltd., of Zurich, and organized a team which produced outstanding results in the field of turbine, pump, and propeller design.

In 1928 he established the linearized supersonic theory named after him, at the same time introducing the now well-known term of 'Mach number' for the ratio of the speed of flight to that of sound.

His work on the problem of cavitation was published as a chapter in the Textbook of Experimental Physics.

United States

MODERN SURVEY METHODS

Highway Information Services, of Washington, D.C., tell of the latest methods being used on surveys of routes for the construction of the new 41,000-mile National Interstate System of superhighways.

To establish the numerous ground control points, use is made of the tellurometer, basically a system that measures distances between a transmitter and a receiver of microwaves from the transmission and return interval. Weather conditions do not affect the measurements, and there is no need for the operators at the two points to be within sight of each other. The net result is an immense saving in time and cost.

The method is accurate to about one part in 300,000 on long stretches, or about 11 inches in 40 miles.

Each unit, transmitter and receiver, can be packed by two men, and the procedure is for the transmitter team to set up at a base line while the other team goes ahead to the 'unknown' point previously set by a reconnaissance crew. Contact is established by swinging the transmitter until a maximum signal is returned, as indicated on an oscilloscope. Both teams can talk to each other by radiophone. (See cut)

The transmitter then sends out signals and measures the return interval, using five to ten coarse and fine readings from a band of 20 frequencies to ensure accuracy.

A refinement of the technique has been used in Virginia to establish second order traverse stations every few miles along the centreline, running them in from Coast and Geodetic Survey stations about 15-20 miles apart and several miles off the proposed route.

This refinement involved the use of a chartered helicopter to ferry crew members with their instruments from one hill top to the next. In average weather it was found that the four-man crew could establish points at the rate of one an hour, including reconnaissance and turning angles.

The helicopter averaged 50 short flights a day, many of which took only a few minutes compared with an hour of hard climbing with all the equipment.

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

St. Lawrence Seaway and Power Project

Progress by Ontario Hydro

Weather conditions generally throughout the month of April were favourable for construction work. The project work staff was increased slightly and at month end there was a total of 2,730 workers.

The No. 5 turbine runner assembly was put into position in the unit during April. All the head gates were in place and work on the hoists was well underway. Seven sump installations had been completed. During the month, the compression room work advanced favourably and was about 75 per cent completed.

Stator frames were installed in units number five and seven and the windings were started on these sections of the generators in the Canadian half of the power-house during the month. Lower bracket was installed in number four unit. Assembly of the rotor for number four unit was about 90 per cent completed, while the work of assembling the rotor for number two unit was about 70 per cent finished. Both of these rotors will be ready for installation early in May.

All the control equipment had been installed for the first four generator units and approximately 50 per cent of the installation of control cables had been completed. Installation of 230-kv. power cables through the tunnel from the power-house to the terminal structure had been started. The switch gear building for units five to eight was nearly complete and installation of electrical equipment had commenced. Meanwhile, wiring was progressing favourably in the control room.

The 1958 program in the 230-kv. section of the St. Lawrence transformer station was approximately 70 per cent completed. At the month end, work had progressed on the control building so installation of equipment could be started. Installation of circuit breakers at the transformer station was well advanced.

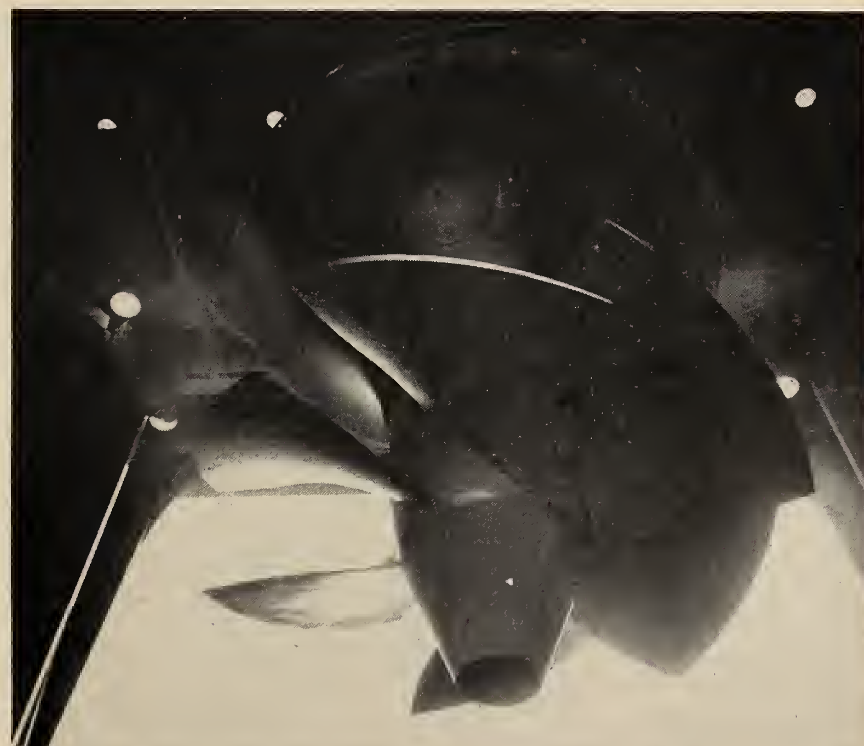
Rail connections to the power-house from CNR were removed. Work was resumed on the railway overpasses. At all four dredging contracts to improve the channel, the equipment was at work. Dragline operations were proceeding to remove the upstream half of the cofferdam at Point Three Points.

Final clean-up work was underway from Iroquois east and from Cornwall west to clear the north shore of the St. Lawrence in preparation for flooding.

It was later made known that the 34,000 acre headpond would be flooded early in July. Control will be established, in a 4-day process, by the Iroquois dam, the Massena intake, and the Long Sault dam, and the headpond for the international power-house will be brought to a predetermined operating level. Shortly afterwards, the power turbines will go through their first test run under operating conditions.

Progress by NYSPA

April was highlighted by the flooding of the area between the downstream side of the power plant and



St. Lawrence Power dam. The runner assembly for Unit 28 is suspended by gantry crane before lowering into place in unit.

cofferdam C1. Concrete in place for all structures totalled 1,976,000 cubic yards or 96 per cent of the estimated total. Excavation quantities had reached 50 million cubic yards or 94 per cent of the estimated total. Employment averaged 3,200 for the month.

At the American half of the power plant some 16,000 cubic yards of concrete were placed, bringing the total placed to 964,000 cubic yards. Cofferdam C1 was breached on April 1, and the tailrace area was filled to the level of the river on April 6. Steel piling is being extracted from the cofferdam cells adjacent to the international boundary. Five motor control centers were energized in the power plant. Aluminum conductors were being strung on the Reynolds Nos. 1 and 2 and Alcoa No. 6 transmission lines.

At Long Sault dam, removal of cofferdams "DU" and "DD" was completed except for one cell which will be removed when the construction bridge is removed. The entire flow of the river was being diverted through the diversion tunnels. Approximately 91 per cent of the required concrete had been placed.

Channel improvement work continued in the upstream and downstream areas of Toussaints Island. At Point Three Points sweeping of the upstream spoil area to elevation 211 with a drag beam was completed. Channel work on the entire project was now 94 per cent completed.

On the Barnhart Plattsburgh transmission project, all phases of transmission line construction continued despite soft ground conditions. Steel tower erection was started for the north extension of the Adirondack transmission line.

Progress by SLSDC

Employment during April increased slightly over the previous month to about 700 persons, due mainly to resumption of dredging. At the month-end excavation on the Long Sault canal was practically completed but considerable excavation remained on the approach to the Grass River lock, where a dredge and dragline resumed work late in April. Completion to 14-ft. depth is assured by July 1st and to 27 ft. depth by year end. Machinery installation on both American locks was practically completed, but no water was yet available for testing the locks.

On the dredging for the south Cornwall channel, two out of six contracts were completed but the remainder will continue throughout the summer. The channel will be open for 14 ft. navigation by July 1, 1958.

Erection of steel for the superstructure on the new high-level bridge to span the south channel between Cornwall Island and the U.S. mainland, commenced early in April, had been completed on several spans at both ends. Completion of the repair work on piers by SLSA will permit erection of the main span to be started in May. It is expected the bridge will be available for highway traffic by the end of November. Preparations were being made for removal of the south span of the old Roosevelt bridge at month-end. Falsework erected on barges will support the span, which will be floated out early in May.

Progress by SLSA

With good construction weather in April and with the ice moving out, resumption of some dredging operations increased employment to some 5,700 persons. Excavation of the channel from the Montreal harbour right through to the Caughnawaga bridge opposite Lachine was well in hand.

At the St. Lambert lock, with placing of concrete completed, regulating channel finished and gates for it installed, the only work remaining apart from gate installation was control houses and backfill. Installation of upstream mitre gates was complete, with machinery being installed, though no progress was reported on the lower leaves. All four taintor valves were in place and operating machinery was going in. Fenders were all in place.

At the Côte St. Catherine lock, installation was progressing on both the sector gates and the rolling lift bridge. Though excavation was being cleaned up around the lock itself there remained considerable material to remove at the turning basin.

At the lower Beauharnois lock, with rock excavation continuing throughout April and 236,000 cubic yards of concrete placed, the lock chamber was completed except for part of the west wall and part of the upper gate section. A start had been made on placing the gate hinges but installation of both mitre and sector gates had not been commenced.

On the upper Beauharnois lock, with excavation still continuing, 33,000 cubic yards of concrete were placed during April, leaving a part of the upper gate section still to be poured. Preparations were under way for installing the gates. With 80 per cent of the steel erected for the New York Central swing bridge at the upper end, completion of the bridge is scheduled for late in May. This section of the navigation channel, including the two Beauharnois locks, is said to be the most expensive mile on the entire seaway.

Some 2 million yards out of a total of 3 million had been removed by Canada from the tip of Cornwall Island at the international bridge. A further 700,000 yards must be removed before July 1. Work of dredging on the north channel is in progress and it appears probable enough material will be removed by the same date.

Bridge Construction

Work was progressing rapidly on bridges. Jacking up was continued on piers 1 to 13 of the Jacques Cartier bridge and work had commenced on filling at the south abutment. At the Victoria bridge the first pier north of the dike to carry the diversion of the CNR track on the upstream side had been poured and a second one was formed.

On the CPR-NYCR railway bridge at Caughnawaga, concrete was being placed in the counterweights on the lift-towers, and derrick was being dismantled in preparation for opening the bridge to rail traffic by June 1st.

On the Honore Mercier bridge, erection of steel for the span over the seaway channel was nearing completion. Two girder spans north of the channel and four south of it remained to be erected. Forms were placed for the roadway deck on several of these girder spans but no concrete had yet been placed.

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Following an inspection of work in progress and the results of tests, a board of consulting engineers appointed jointly by SLSDC and SLSA approved on April 14 the remedial work being carried out by SLSA on the main piers of the south channel high-level highway bridge at Cornwall. This will permit erection of the steel for the main span about the middle of May.

Seaway News

Opening of the Welland canal for navigation took place on April 1 this year, while the Soulanges and Lachine canals were opened for 14 ft. shipping on April 17. The Great Lakes ore shipping season, however, did not get under way until late in April.

Winter Navigation of St. Lawrence

Shipping authorities are showing optimism concerning year round navigation, but maritime communities fear it would take business away from Atlantic ports. Year round navigation is expected as far west as Quebec within a few years and an open river to Montreal is considered possible, though cost of keeping harbours open and higher insurance rates are seen as limiting the advantages. So far as the seaway is concerned there is considerable caution expressed.

Cost of Widening Welland

In a memorandum to the New York State Power Authority, Major-General T. F. Farrell said there will be no need in the future for a second Welland canal. When tonnage exceeds Welland capacity, he states, additional locks and more widening can be provided. To double existing locks and to do more deepening would cost about $175 million, he estimates. A parallel canal on Canadian soil would cost about $540 million, he says.

To build an all-American canal between lakes Ontario and Erie would be possible on two routes. The Lasalle-Lewiston route would cost some $600 million. To build one along a route between Olcott via Lockport to Tonawanda, N.Y., would probably cost more. While dismissing the possibility of an all-American canal, General Farrell admits a large Welland may be needed some time in the future, nearly equal to the capacity of the new seaway.

Shipbuilding Association Issues Warning

A newsletter circulated on April 1st by the Canadian Shipbuilding and Repairing Association warns that unless appropriate action is taken, Canadian industries could become more dependent on foreign agencies for essential services. If the seaway is to be open for United Kingdom vessels to engage in the Canadian coastal trade, Canadian ships may be driven out of business and Canada's shipyards may either close down or be reduced to repair yards. U.K. ships are built and repaired in yards which pay lower wages while U.K. seamen get lower rates than Canadian. The imminence of the seaway, the Association claims, is a potent argument for reserving our coastal shipping trade for Canadian built and registered vessels.

The *Journal* Reports Growth in Engineering Faculties in Canada

Sixth article of a series

The Faculty of Applied Science, Queen's University

Queen's University, in the process of adding new specialized space, both in new buildings, and in the reconditioning of old buildings, is making provision, though not definite plans, for larger numbers of students in the Faculty of Engineering.

In the actual building program there is an engineering building, intended primarily for civil engineering. This building, now being constructed, should be open for classes in the fall of 1958.

The cost of the building and equipment is estimated at $1.8 million, and the total floor area, 100,000 sq. ft.

The plans for the future are indefinite in detail, but it is known that considerable expansion will be required in Physics and Chemistry, and later in the other engineering departments.

Engineering courses at Queen's are under continual revision, Dean of Engineering H. G. Conn reports. A good deal of the initiative for this comes from the Advisory Committee on Engineering, which is composed of approximately thirty-five engineers from industry.

At the graduate level a fifth year of course work is being offered in the fall of 1958, leading to a Diploma in Engineering. For the first few years this fifth year will deal mainly with reactor theory and design.

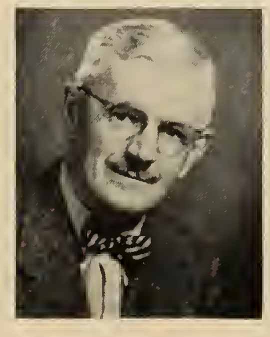
At the undergraduate level an option in petroleum geology and in geology as applied to civil engineering is being offered.

College of Engineering University of Saskatchewan

The College of Engineering at the University of Saskatchewan has expanded in enrolment in the past five years from 585 students to 1,103. The University as a whole has experienced a similar increase, the student body now numbering about 4,100, as compared to the 2,500 of five years ago.

A special course in Mechanical Engineering was provided during the past year, which includes more mathematics than the regular course. Students in this course take as much mathematics as is given in engineer-

Dean I. M. Fraser



Dr. Arthur Porter

Prof. J. B. Mantle

ing physics.

While there have been no additions to the Engineering Building, the problem of space will be eased. A new service building for the department of the Superintendent of Buildings is being erected. This will give considerably more space to the engineering faculty, when workshops are moved out of the engineering building. A new Arts Building and a new Biology Building are planned for early construction, and they will also release space in the engineering building for engineering classes. The P.F.R.A. service has moved to a new Science Services building on the campus completed last year by the Dominion Department of Agriculture.

Dean I. M. Fraser Retiring

There will be personnel changes in the College of Engineering, necessitated by the retirement in September, 1958, of Dean I. M. Fraser, dean of the College and head of the Mechanicial Engineering Department.

Dean Fraser came to the University of Saskatchewan in 1921 as assistant professor of mechanical engineering. He was appointed head of the Department in 1937, and dean of the College in 1953.

Originally from Pictou, Nova Scotia, he is a graduate of McGill University, receiving a B.A.Sc. degree in 1919.

The professional associations have benefited from his participation. A member of The Engineering Institute of Canada since 1920, he was vice-president in 1953-54. He is also a member and past president of the Association of Professional Engineers of Saskatchewan.

Dr. Arthur Porter Appointed Dean

Dr. Arthur Porter will succeed Dean Fraser as dean of the College of Engineering. Dr. Porter is professor and head of the department of electrical engineering at the Imperial College of Science and Technology at the University of London, England.

Dr. Porter is a recognized authority on automatic control systems in industry and on the development of large scale computors. He is the author of numerous research articles and of a book entitled "Introduction to Servomechanisms".

A graduate of the University of Manchester, with first class honours in physics, he received the degrees of master of science and doctor of philosophy from the same university. He was later a Commonwealth fellow in electrical engineering at the Massachusetts Institute of Technology.

During World War II Dr. Porter was senior scientific officer in the British Admiralty. In 1946 he was appointed head of the Department of Technology in the Royal Military College of Science. From 1950 to 1955 he was head of the research division of the Ferranti Electrical Company, engaged in the development of large scale computors.

J. B. Mantle to head Department

Professor J. B. Mantle, professor of engineering, has been appointed head of the Department of Mechanical Engineering, to succeed the retiring Dean Fraser in this post.

Professor Mantle is a former student of the department he will now direct, for he graduated in 1941 from the University of Saskatchewan with the degree of B.E. (mechanical). He received the degree of master of science from the University of Illinois in 1947.

During 1941 and 1942 he was employed by Canadian General Electric, and from 1942 to 1945 was an aeronautical engineering officer with the R.C.A.F.

His first appointment at the University was in 1945, as instructor of engineering; later appointments were these of assistant professor, in 1947, and professor of engineering, 1957.

In recent years he has done special research projects during the summers, having research associateships with the National Research Council. Since 1948 he has published four technical papers on experimental stress analysis.

Prof. Mantle is a wing commander with the R.C.A.F. reserve.

New Appointments

W. R. Staples, professor of engineering, will hold a newly created part time position, assistant to the dean of engineering, while continuing his present duties.

Prof. Staples will assist Dr. Arthur Porter with the routine involved in dealing with individual students.

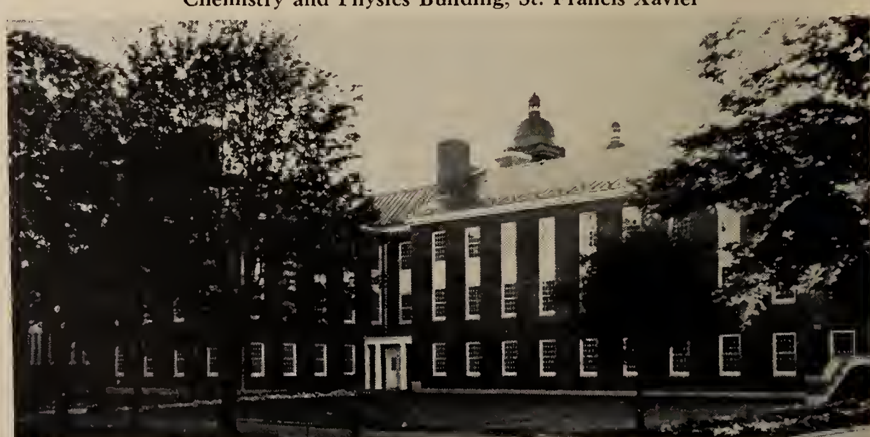
Dr. R. B. Shearn, professor of petroleum engineering, has resigned to accept an industrial position in England. His place is being taken by T. E. W. Nind (Cambridge and Royal School of Mines) who has since 1950 been with the Royal Dutch Shell Group in Venezuela, Borneo and Holland.

Chemistry and Physics Building
St. Francis Xavier University

The biggest single step in expansion of facilities at St. Francis Xavier University culminated on August 29, 1957, with the opening of the new Chemistry and Physics Building, at an approximate cost of $1 million. The building is a T-shaped structure designed by Jens Frederick Larson, noted United States university architect. It is the fifth building designed by him for St. Francis Xavier and the sixteenth building on the campus. It provides 17,000 sq. ft. of work and study space and has a cubical content of 600,000 cu. ft.

Chemistry facilities provide for eighteen laboratories plus facilities for eighteen students and professors to engage in research. The chemistry section can handle comfortably three hundred students at a time. In addition to a main supply room each laboratory has its own storeroom and preparation room, and there is a

Chemistry and Physics Building, St. Francis Xavier



Engineers at work in new drafting room, St. Francis Xavier

radio-chemistry laboratory equipped to handle radio-active materials and the disposal of radio-active waste.

Physics facilities provide for ten laboratories which can accomodate 260 students. Besides the regular laboratories there are a spectrometry laboratory and two research laboratories, and a room for advanced optics.

The building also includes a common library, 20 by 50 feet, and seventeen offices which are provided for the staff. Services to the laboratories, all concealed in service ledges, include hot, cold and distilled water; a-c and regulated a-c power, as well as d-c power from storage batteries; a 20 kilowatt generator, gas and compressed air. Six balance rooms provide fifty balances, and there are also a woodworking shop, a machine shop and an instrument repair shop.

The building is of red brick with a roof of concrete sheathed in copper. It is heated and ventilated by an intricate system of fans which feed into decorative chimneys.

In line with current expansion, the MacNeil Science Hall has been renovated, providing two new drafting rooms, each accommodating a total of 65 students, and the rest of the structure has been renovated to provide five new classrooms and offices for the engineering staff.

Experimental Program

A new experimental program which isolates the top quarter of the class for special work in English, mathematics and physics has already been put into effect in the freshman year. Freshman year currently stresses more intensive work in English; concentration in second year will be in mathematics, and in the third year in physics.

Canadian Pipeline Projects

Trans-Canada Pipelines

Some 3,000 men will be working this year in the field on building the final 853 mile link between Lakehead and Toronto. At the end of April, some 480 miles of right of way had been cleared, 104 miles graded, while pipe had been strung or stock-piled along the route for 725 miles of line. In addition to actual pipeline construction, six compressor stations will be built with a total of 48,500 h.p. Cost of the 1958 construction program will be approximately $165 million.

Threat to Trans Canada's Export

Canadian gas will not be exported to Midwestern Gas Transmission if a proposal by F.P.C. counsel in Washington is acted upon by the Commission. Counsel recommended Midwestern's application be dismissed in favour of Northern Natural Gas for extending its service. If the case is rejected by F.P.C. the whole position of Trans Canada will be changed. Two courses are open to Trans Canada, — it can drop the entire contract with Midwestern and look for another export contract, or it can await the possibility of a later revival of the Midwestern project under different conditions. Obviously the American gas companies, having disposed of their interests in Trans Canada, are not prepared to wait indefinitely for a decision from Ottawa on an application for permission to export.

Inland Natural Gas

Nearly 10,000 homes and businesses have applied to Inland for gas service, and sales of appliances from company showrooms have skyrocketed, a recent progress report indicates. The company's construction program is completed.

Saskatchewan Power Corporation

Contracts for the 1958 main S.P.C. gas pipeline extension program including gathering systems in Hatton and Many Island fields were awarded in April. The estimated cost of materials is $7 million. Pipe will be supplied by Prairie Pipe Manufacturing Company of Regina, with a small quantity from Alberta mills for the Alberta lines. Largest unit, 124 miles of 10-in. and 38 miles of 12-in., from Steelman via Regina to Moose Jaw was awarded to Fulton-Bannister Ltd. at $768,500. Engleking and James Ltd. of Edmonton were awarded 88 miles of 14-in. and 3½ miles of 16-in. main between Hatton field and Success, as well as the 22 miles of the Many Island gathering system on the Alberta side, at a price of $809,000. Swift Current Construction Ltd. was awarded the Many Islands gathering system and wellhead hook-ups consisting of 18 miles of smaller pipe, at $110,000, while Robb Construction Ltd. will build the 25 mile Hatton gathering system for $96,500.

Intercity Gas

This Winnipeg company serves Portage La Prairie, Neepawa, Rivers, Hamiota, and Steinbach, containing some 4,300 available customers. Company commenced its first sales of natural gas last October. Besides a 70 million feet per year industrial customer in Portage the company will supply 110 million cubic feet per year to the Joint Air Training Centre at Rivers.

Winnipeg and Central Gas

Manitoba Royal Commission on Natural Gas headed by J. J. Deutsch, Professor of Economics at U.B.C., opened hearings in Winnipeg suburbs in mid-April. Before it was an application by the suburb of St. James asking approval of a deal with Great Northern Gas Utilities Ltd. at an average rate of 81 cents per 1,000 cubic feet compared with Winnipeg and Central's $1.03 rate. Winnipeg and Central, now sole distributor in Winnipeg, is applying for a rate reduction. Its rates have been attacked by two other companies hoping to break into the Greater Winnipeg market. Main saving under the proposed new rate, which must be ratified by the Municipal and Public Utility Board, will be on water heaters and would be about $100 per month.

Northern Ontario Natural Gas

The company's expansion plans under study involve extension of laterals to the Blind River-Elliot Lake uranium field, the iron ore centre of Steep Rock at Atikokan, the Manitouwadge base metal camp and pulp and paper operations at Marathon, Terrace Bay and Sioux Lookout. The 34 communities to be served by the company and its affiliate, Twin City Natural Gas, have an estimated population of 306,000. Estimated total construction cost in this area is $30 million, with a further $15 million for additional expansion. Delivery of gas by Twin City to customers in Port Arthur, Fort William and Dryden commenced on May 1st. Communities of Red Rock, Nipigon and Geraldton, with 93,000 customers, will receive gas late in the summer of 1958.

Union Gas Company

Union acquired last year a third gas field suitable for storage. Its three storage fields now have a combined capacity of 33.7 billion cubic feet. Natural gas service for Guelph and Stratford began last December. Through acquisition of Dominion Natural Gas Company of Brantford, the company will serve a large number of communities in the south western portion of the province along the shore of Lake Erie and in the Niagara Peninsula.

Consumers' Gas Company

Consumers' Gas plans to carry out a vigorous expansion program over the next five years involving the expenditure of some $75 million. Capital outlay in 1958 alone is expected to reach $24 million. Early this summer construction will be started on transmission lines and distribution systems that will provide service to about 20 Georgian Bay and Ottawa valley communities this year. The main 8 inch pipeline will start from its connection with Trans Canada north of Barrie to serve Owen Sound, Stayner, Collingwood, Meaford, Midland and Penetanguishene. In eastern Ontario the main from Brockville will serve South Falls, Carleton Place, Almonte, Arnprior, Pembroke and Renfrew.

Lakeland Natural Gas

Lakeland Natural Gas Ltd. has launched a $2.75 million program to distribute and extend gas service to Port Hope, Cobourg, Trenton, Belleville, Napanee, Ganonoque, Prescott and Cornwall. Contract has been awarded to Donovan Construction Company of Canada. The project will employ close to 200 men. A special contract awarded to A. F. Simpson, marine pipeline contractor, involves laying of pipe across the Trent River at Trenton.

Quebec Natural Gas

Conversion to natural gas for 38 distributing districts covering 250,000 customers, commenced last January, will be completed by the end of May when gas is supplied from Alberta at the end of this year, the company estimates the cost will range between 41 and 48 cents per Mc.f. of 1000 B.t.u. gas. Hydro-Quebec's average cost of manufactured gas for the year 1956 was approximately 58 cents per Mc.t. of 465 B.t.u. gas or $1.25 per Mc.t. of 1000 B.t.u. equivalent. While new rates are not yet set, indications are that the rate in Montreal for 2500 c.f. monthly will be as much as 25 per cent lower than the Toronto price.

Federal Control A Threat

Federal jurisdiction over natural gas and other pipelines connecting with lines that cross provincial boundaries was again criticized by the Saskatchewan government in a brief to the Borden Commission at Regina on April 14. The brief warned it may be argued that federal jurisdiction respecting permission to build a pipeline extends back from a main trunk line crossing a provincial boundary, to a connecting trunk line built wholly within a province, and eventually might extend back to wellhead itself, making a mockery of provincial jurisdiction over natural resources. Saskatchewan is presently fronting for the whole petroleum industry in the contest to keep federal authority within legal bounds.

Canadian Gas Consumption

Gas consumption in Canada for the full year 1957 amounted to 16 billion cubic feet of manufactured gas and 168.9 billion cubic feet of natural gas, — total of 184.9 billion cubic feet compared with 163.7 billion feet in 1956. The percentage of total natural gas production showed a rise from 87.8 per cent in 1956 to 91.3 per cent in 1957, while the percentage supplied by manufactured gas fell from 12.2 per cent in 1956 to 8.7 per cent in 1957.

What Goes On

Economic Survey of Alberta

The first copy of an economic survey entitled, "Alberta, Province of Opportunity," was presented to a representative of the provincial government by G. A. Gaherty, president of Calgary Power Ltd., on May 16, 1958.

The survey forecasts a dramatic growth for primary industry in the Province, and a further growth of secondary industry whose factory shipments in 1957 were seven times those in 1939. Between now and 1975 the net value of production of secondary industries will increase nearly four times, reaching $800 million. A growing population will encourage this development.

These are some of the predictions brought out by the survey: Construction should triple, reaching $1 billion. Mining will be five times its present net value, becoming $1,600 million. Electric power will increase nearly five times and forestry three and a half times. The province's net value of production will increase three and a half times.

The survey points to a prosperous future and the capacity for continued expansion. It analyzes the history of the economy, studies the resources, the electric power and the primary industries. It details the growth of manufacturing and service industries, and analyzes the conditions necessary for such growth. The survey recommends a number of industries that might be established in Alberta.

Medical Research Advanced

A simple mechanical device enabling surgeons to quickly interconnect the ends of a severed blood vessel has been developed. Apart from its obvious use in accident cases, the new technique will greatly facilitate the implanting of grafts used to replace diseased sections of blood vessels. The group of specialists responsible for this achievement are Dr. I. J. Vogelfanger, Dr. W. G. Beattie, of the Ottawa Civic Hospital, and G. J. Klein, A. J. Smialowski and C. L. Fisher, of the National Research Council.

For physiological reasons, the vessel ends that are to be connected must be flared outward while the suture is being made in order to obtain contact between the inner surfaces, and the finished connection must be substantially free from internal protuberances.

The new device forms the suture by driving a set of small U-shaped tantalum clips in a single squeezing action. The clips are held in an assembly resembling a split bushing and are clinched by being driven axially into a set of anvil recesses in the end of a second split bushing. A number of sizes of bushings are used to cover a fairly wide range of vessel sizes.

In use, a clip-driving bushing and an anvil bushing of the appropriate size are mounted in separate clamps. One end of the vessel is threaded through one of the bushings and is turned inside out over the end of the bushing. The other end of the vessel is prepared in the same manner on the second bushing. The two bushing clamps are then coupled together in accurate alignment and the clips are driven home. The bushing clamps are released and withdrawn, the half sections of the bushings are removed and the operation is completed by turning one of the vessel-ends right side out over the other end which is left everted.

The device has been used with outstanding success in a number of experimental operations on the aorta of live animals. It greatly reduces the time required to perform the anastomosis and reliably produces perfect sutures even in quite small vessels. In the case of small vessels, it may open a door to a field of surgery which heretofore has been regarded as involving too great a risk.

Commercial production of the device has not been undertaken up to the present time.

Businessmen Visit U.S.S.R.

In May a group of thirty Canadian businessmen visited the U.S.S.R., where they had the opportunity to meet representatives of different Soviet organizations, depending on their interests.

Among the participants were the following members of the Engineering Institute: Dr. Otto Holden, chief engineer, Hydro Electric Power Commission of Ontario; T. G. Irving, managing director, Robert McAlpine Limited; J. W. Kerr, vice-president and general manager, Canadian Westinghouse; A. D. Margison, president, A. D. Margison Associates Ltd.

Spiral tunnels of C.P.R. line are being relined.

Spiral Tunnels of CPR

The spiral tunnels on the C.P.R. line between Hector and Field, B.C., are being relined, in a 10-year operation planned so that traffic is uninterrupted.

Due to various rock formation in the original tunnel excavation, reinforced concrete was chosen as the best lining material to meet varying conditions. Where sidewalls and ceiling are relatively stable, it was possible to remove the timber lining and apply a thin layer of gunite over the exposed rock in the roof. A simple system of small reinforced arch ribs, at about 5 to 6-ft. centres, was then placed by the gunite process with a mesh reinforcing gunite layer over the intervening areas of the roof.

Tunnel lining through loose and unstable rock is more substantial. Forms are constructed between existing posts, reinforcing installed and concrete poured up to the arch springing. Arch reinforcing is then placed and ribs gunited. Timber sets are subsequently removed, wire mesh installed across the space, and approximately 4 inches of gunite added to seal the openings. Struts near the base and at the springing are concreted later to complete the lining. The completed section is then pressure grouted to fill any voids between the lining and the rock walls and roof.

The project has been in progress for four years; 1865 feet of lining (of a total of 6,176 feet) have been completed. The work, employing 29 to 32 men from May to October, has been carried out by Creaghan and Archibald, Montreal, and supervised by the Railway's division engineer, M. S. Wakely.

Shawinigan Anniversary

The Shawinigan Water and Power Company, marking its 60th anniversary in 1958, reports a revenue for 1957 of $63 million, and a generating capacity of 1,284,000 kw.

At the end of 1958, when the Beaumont station will be in operation, the company will have seven generating stations on the St. Maurice River in Quebec. All these stations were designed and built by a wholly-owned subsidiary, The Shawinigan Engineering Company Limited. In 1957 the company acquired control of Southern Canada Power Company Limited. Including Southern Canada and the subsidiary, Quebec Power Company, customers served now total 444,000. Total assets, including holdings in Shawinigan Chemicals, total $335 million.

The Beaumont development should, together with present resources, provide adequate power supply till the fall of 1962. The company expects to spend some $95 million over the five years 1958-1962 for completion of Beaumont and for additions and improvements to the transmission and distribution systems.

HELP WANTED

Engineer Required for Institute Headquarters Staff

There is a vacancy in a full time position at E.I.C. Headquarters in Montreal for a well qualified engineer, to administer the Institute's increasing program of Technical Services. Responsible to the General Secretary, he will assume the direction of publications, all technical operations, branch technical development, and other associated work. The successful applicant will be expected to have the necessary technical background, plus administrative ability and some proven editorial aptitude.

This is an interesting opening, with ample scope for the right person. While age will not be a determining factor, it is probable that the man with the necessary qualifications will not be less than about 40 years old. Some preference will be given to members of the Institute. Address written applications with full particulars, to

The General Secretary,
Engineering Institute of Canada,
2050 Mansfield St.,
Montreal 2, Que.

All letters will be treated confidentially, and should be so marked.

Power in New Brunswick

Up to March 31, 1958, Unit No. 1 at the Beechwood hydro electric plant on the St. John River had produced close to 93 million kwh of electrical energy in 147 days, while Unit No. 2 had produced 27.5 million kwh in 63 days. The units went into production on November 4, and January 27 last.

This project of the New Brunswick Electric Power Commission was described by The Honourable Edgar Fournier, chairman of the Commission, in a report to the provincial legislature, late in April.

Foundation Maritime Limited had been the contractor on the project from 1955. In 1957 the major work consisted of construction of the power house superstructure, erection of the two turbines to the satisfaction of Dominion Engineering Works Limited, installation of all piping and mechanical and electrical equipment, erection of the outdoor switching station. Other major work carried on at Beechwood during 1957 consisted of erection of the two 40,000-kva. generators by Canadian General Electric Co. Ltd., erection of the sluice and regulating gates and hoisting apparatus, as well as of indoor and outdoor cranes by Dominion Bridge Co. Ltd. Six miles of railway were diverted or raised at five different locations. Highway works consisted of six diversions and one highway lift, a total of 6.8 miles being relocated or raised.

Interior of Beechwood power house, New Brunswick.

Expansion in Operation

During 1957 the New Brunswick Power Commission, Mr. Fournier reported, experienced the greatest growth in its history.

Among the plans being worked out is the interconnection of the electric systems of New Brunswick and Nova Scotia. Under this plan, one province will be able to draw from the other for capacity at any time, the result being increased reliability of power. The line will have a normal capability of 50,000 kilowatts, but an emergency capacity of 75,000 kilowatts.

The total production by all generating stations during the year ending March 31, 1958, reached 611 million kwh., an increase of 8.6 per cent. The proportion produced by hydro power was 40.6 per cent, the remainder generated by steam.

A good portion of the increased production resulted from sale of at-will power to pulp and paper companies. Beechwood was tied in with the Grand Falls plant of Gatineau Power Company. Beechwood also made possible the sale since November of 150,000 kw. daily to Maine Public Service.

Water-Power Resources of Canada

The currently recorded water-power resources of Canada are shown as totalling more than 46 million horse-power under conditions of low stream flow, and over 66 million horse-power at average flow. This information is given in Bulletin No. 2602 of the Department of Northern Affairs, titled "Water-Power Resources of Canada".

The statistics would indicate that less than 25 per cent of available resources has been developed. During 1957, new capacity to the extent of 1.5 million hp. was brought into operation.

Copies of this review may be obtained free of charge from the Director, Water Resources Branch, Department of Northern Affairs and National Resources, Ottawa.

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

The Seventy-Second Annual General Meeting

Nearly a thousand members, wives, and guests came to Quebec City, May 21-23, for the seventy-second annual meeting of The Engineering Institute of Canada.

Their response augured well for the success of the meeting, and their confidence was not misplaced. The smooth course of the events at the Chateau Frontenac was a credit to the splendid preparation of the Quebec Committee, and to the hospitality of the Quebec Branch, its chairman, Roger Desjardins, its officers, and its members. The Quebec Committee was composed of Ben O. Baker, chairman, Roger Desjardins, Pierre Duchastel, L. P. Bonneau, Louis Joncas, Jacques Roy, Paul Begin, Jean B. Delage, Marc Bergeron, Mme Roger Desjardins and Mrs. Ben O. Baker.

Many ladies came to the meeting with their husbands, and enjoyed the special program that had been arranged for them. A coffee get-together every morning was a pleasant event. Tours of Quebec and a fashion show were available when the ladies were not participating in the general program.

This was a memorable meeting. It marked the retirement from the office of general secretary of Dr. L. Austin Wright after twenty years of distinguished service, and gave the members present the opportunity to express for themselves and for the branches they represented, appreciation of his service. The following pages give a full account of his career.

Dr. Wright's successor as general secretary, and editor of *The Engineering Journal*, is Dr. Garnet T. Page, M.E.I.C., who has been deputy general secretary since January of this year. Dr. Page is the former general manager of The Chemical Institute of Canada (See The Engineering Journal, October, 1957, Page 1490).

The office of president of the Institute for 1958-59 was given into the hands of Kenneth F. Tupper, president of Ewbank and Partners, Toronto, by the retiring president C. M. Anson, of Sydney, N.S. Mr. Anson gave his review of the accomplishments of the Institute in 1957-58 at dinner on May 21. Reporting a particularly healthy condition of the Institute, it is well worth reading, and will be published in the next issue of the *Journal*.

As always the welcome support and collaboration of other societies was apparent from the presence of their members and official delegates.

The Program

The program started on Tuesday, May 20 with the Student Conference and the Education Conference.

Institute business was taken up on Tuesday morning. The Branch Officers Conference brought together delegates from the Branches for discussions of cooperation with and service to the Branches, which now number 50 across the country.

The Annual Meeting of Council was held on Tuesday morning, and the Annual General Meeting on Wednesday morning. The new Council of the Institute met for the first time during the meeting. The minutes of the Annual General Meeting will be published in an early issue.

The authors of the technical papers met each day at breakfast with the members who were to preside at their sessions. The technical sessions were well attended, and considerable interest was aroused by the thirty-two papers presented. Discussion had been invited in advance and a number of significant contributions were made.

Laval University, in a special convocation on Wednesday evening, bestowed on President Elect Kenneth F. Tupper the honorary degree of Doctor of Science, before a large audience.

Thursday afternoon and evening provided a recess from technical and business affairs, with the Quebec Branch arranging an afternoon cruise on the St. Lawrence River. This was a great opportunity to sample the famous scenic beauty of Quebec in the best of company.

The evening program was an innovation, starting with a session in Muriel's Room, and a fine buffet supper. Later, well warned to dress informally, the members more than willingly took part in a Habitant Frolic featuring folk dancing and singing. The scene was set by a French Canadian troupe of singers and dancers in costume.

The Association of Consulting Engineers of Canada held their annual dinner on Thursday evening, continuing their custom of associating their meeting with that of the Institute.

At luncheon on Friday, honours and awards of the Institute were presented by President C. M. Anson, Chairman of this luncheon was Vice-President Albert Deschamps.

Friday evening was the highlight of the meeting, the annual banquet and dance. The speaker, R. G. Gustafson, president and executive director, Resources for the Future, Inc., Washington, had a large audience for his very interesting address.

The introduction of the new president, vice-presidents and councillors of the Institute was a feature of the annual dinner, with C. M. Anson presiding.

Guests of the Institute at dinner were representatives of the Canadian Services, and of thirteen sister societies, Canadian, American and British.

E.I.C. Honours and Awards, 1958

These awards were presented during the annual meeting to those recipients who could be present.

HONORARY MEMBERSHIPS

Armand Charles Crepeau, Sherbrooke,
Sir Claude Dixon Gibb, Newcastle-upon-tyne, England.
Philip Louis Pratley, Montreal, Que.
Irving Richard Tait, Montreal, Que.
Earle Oliver Turner, Fredericton, N.B.
Leslie Austin Wright, Montreal, Que.

JULIAN C. SMITH MEDALS

Richard Edgar Heartz, M.E.I.C., Montreal, Que.
Robert Edwards Jamieson, M.E.I.C., Montreal, Que.

ROBERT W. ANGUS MEDAL

Russell J. Kennedy, M.E.I.C., Kingston, Ont.

DUGGAN MEDAL AND PRIZE

Robert David, M.E.I.C., Montreal, Que.
G. G. Meyerhof, M.E.I.C., Halifax, N.S.

LEONARD MEDAL

E. O. Lilge, M.C.I.M., Edmonton, Alta.

PLUMMER MEDAL

H. R. L. Streight, F.C.I.C., Montreal, Que.

ROSS MEDAL

Ronald George Griffith, M.E.I.C., Montreal, Que.

H. N. RUTTAN PRIZE

Wilfred Pegusch, JR.E.I.C., Vancouver, B.C.

PHELPS JOHNSON PRIZE

Donald Andrew Chamberlain, JR.E.I.C., Montreal, Que.

ERNEST MARCEAU PRIZE

Gilles Gagnon, JR.E.I.C., Montreal, Que.

JOHN GALBRAITH PRIZE

Charles Murray Stewart, JR.E.I.C., Sarnia, Ont.

MARTIN MURPHY PRIZE

Robert Donald Neill, JR.E.I.C., Fredericton, N.B.

Annual Meeting Quebec, 1958

Annual meeting views on the opposite page: show, top to bottom, first column:

Mrs. M. Armstrong, Windsor; Mrs. Ben O. Baker, head of the Quebec Ladies' Committee; and Mrs. A. C. M. Davy, Vancouver, at morning coffee get-together.

President Anson, (right) made a presentation to J. F. Grenon for the Quebec Branch, marking his more than 50 years of membership. Chairman Roger Desjardins (left) introduced Mr. Grenon.

Dr. Garnet T. Page, whose appointment as general secretary to succeed Dr. L. Austin Wright, was approved by Council during the meeting.

The Branch Officers Conference (top right) and the Council Meeting.

Dr. Lillian Gilbreth was present at the meeting. The group (above) conversing with her includes Chairman Roger Desjardins (right), Louis Joncas (left) and Jacques Roy.

President C. M. Anson received the honorary degree of doctor of engineering at the convocation of Nova Scotia Technical College, before he went to the annual meeting in Quebec.

President-elect Kenneth F. Tupper was awarded the honorary degree of doctor of science at a special convocation of Laval University. He is shown (above) signing the register of the University in the presence of (left) Monseigneur A. M. Parent, rector, and M. l'Abbé Jacques Garneau, secretary-general of the University.

Five newly named honorary members of the Institute are shown in the next group: left to right, L. Austin Wright, I. R. Tait, E. O. Turner, P. L. Pratley and Sir Claude Gibb. A. C. Crepeau, Hon. M.E.I.C., was not present.

Below: Delegates to the E.I.C. Education Conference.

Leslie Austin Wright, HON. M.E.I.C.

A Tribute to Leslie Austin Wright

THE OCCASION of the retirement of Leslie Austin Wright from the post of general secretary of The Engineering Institute of Canada, cannot be otherwise than an occasion bringing forth feelings of sadness and regret. Regret that no matter what the capabilities of a man, time ultimately catches up; and sadness that such has happened to a man of such sterling qualities as Austin Wright.

That the Institute today enjoys such a high standing not only in our own national field, but of equal consequence in the international field, and further that the profession of engineering in Canada has reached such high standards and enjoys the respect with which it is regarded, is in no small measure due to the contribution and the twenty years of devoted service of Austin Wright.

Not only has he contributed so largely towards his profession and to the Institute representing that profession, he has at all times been a Canadian.

During World War II in addition to looking after the interests of the Institute, he contributed to the national activities by being assistant director of the Wartime Bureau of Technical Personnel and subsequently assistant director for National Selective Service of the Dominion.

Shortly after the outbreak of war, he organized the members of Canadian engineering societies to take care of children of British engineers sent to Canada for protection against bombing.

At the request of the government he organized an intensive search among Canadian engineers to develop a countermeasure against enemy explosive machinery which was at that time holding up the invasion of Italy. The result was the production of a completely new device, a device which is still on the secret list.

During the twenty years that Austin Wright has held the office of general secretary, the Institute has grown from twenty-five branches to the fifty branches and from 4,500 members to its present membership of some 18,000.

Of far greater importance is that the Institute has greatly expanded the services which it renders, not only to its members, but to the well being of our country as a whole and beyond that to the service of humanity generally.

Dr. Wright has initiated many of these new services. It is no exaggeration whatsoever to state that the results achieved are in very large measure due to his initiative, persistance and foresight.

I have been privileged to attend international gatherings and to note the high regard with which the bodies comprising those gatherings look upon Dr. Wright. He has the distinction of being the first Canadian to become president of the Council of Engineering Society Secretaries, an organization of some sixty member societies whose overall membership exceeds 600,000.

Should Confederation on a sound basis become an accomplished fact, the engineering profession in Canada will owe a debt in this regard to Dr. Wright. He was the man who envisaged the co-operative agreements that presently work so well between the associations of some seven provinces and the Institute.

His contribution towards bringing *The Engineering Journal* to the high standard that it enjoys today has been extensive. He has been its editor throughout a period of its best growth. He has contributed largely to the other publication efforts of the Institute.

As general secretary he has at all times been a loyal friend and devoted helper to all the incumbents in bringing about such success as has attended the office of President of the Institute.

It is with pride that I exercise this privilege, almost the last official act of my years as President, to record herewith my personal debt to Austin Wright, and of far greater consequence the debt which the Institute owes to a most capable engineer, a true and loyal friend and an outstanding Canadian.

C. M. Anson

L'envoie

Twenty Years Later

IN THE MAY 1938 ISSUE of *The Engineering Journal* the leading editorial entitled "Greetings" opened with these words —

> "This is a new editor speaking. The timorous voice and quaking knees may not immediately be apparent to the audience, but to the editor himself they are painfully in evidence. After some weeks of contemplation, and a few days of experience, the magnitude of the undertaking has more fully dawned upon him, and with this appreciation comes some realization of the obligations and opportunities of the position. Who would not be nervous under such conditions?
>
> "The new editor, and general secretary, has much to learn to be equal to his task. He has great need of the patience, tolerance and kindly assistance of the membership. With these, he hopes to realize his ambitions and to make the most of the opportunities which are now his. There is a great chance in this position to render a real service to the engineers of Canada. It is his sincere wish, and his determination, to be equal to this opportunity. To this end he asks your patient indulgence during his initiatory period, and your kindly assistance throughout his entire term of office."

Looking back over the twenty years it is clearly evident that the members gave abundantly of their "patient indulgence" and "kindly assistance", and that because of it the general secretary was able to share in rendering "a real service to the engineers of Canada".

It was my good fortune to come into office just as the curve of economic prosperity was beginning to climb. It has remained on an upward grade for the entire period. Under these circumstances it was logical that the Institute should prosper. Nevertheless it was a privilege and a thrill to be the executive officer of the organization at that time and to see the great expansion in size and usefulness, with increasing prestige within the profession and in the eyes of the public as well.

In the twenty years I have seen the membership grow from 4,000 to 18,000, the branches from 25 to 50, the *Journal* from an average of 80 pages to 220 pages, the income rise from $75,000.00 to $600,000.00, and the assets from $126,000.00 to $463,000.00, the number of members on committees from 365 to 850. It has been a thrilling experience.

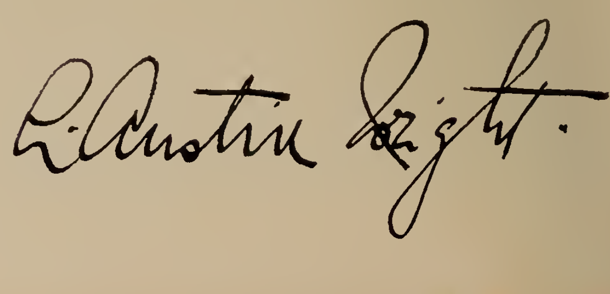
The satisfaction that comes from association with material successes should not be underestimated, but neither should the satisfaction that comes from having made a host of friends in the process. These friendships mean more than all the material gains put together. They are the real reward for the effort made.

To retire from the general secretaryship and the editorship of the *Journal*, to retire from the front rank of Institute activities, is not an easy thing to do, and yet the time has come for it to be done. The pace of engineering affairs is still quickening, the work of the Institute continues to expand, the duties and opportunities of the general secretary are growing beyond all expectations.

The Institute has been so close to me in all these years that its life has become my life, its success becomes the one great thing that matters. It is my belief that to meet the continuing challenge, younger shoulders should now take on the burden. With this in mind we have been building up the secretarial staff with industrious, intelligent and competent younger men. Only under such conditions could I ever leave office without misgivings and concern for the future.

The Institute will go on to greater and greater things, measuring up constantly to the demands of the profession and of Canada. It will be my pleasure now to watch from the sidelines and to applaud as success follows success in all endeavours.

To each of the thousands of members with whom I have had the privilege of working, may I say how gratifying it has all been — the serious discussions, the arguments ending in agreement, the joint efforts to advance the profession, the social affairs, the frequent laughs and the good fellowship. The recollection of these things will sustain me always.



Honours to the Retiring General Secretary

The great service of the retiring general secretary was acknowledged in many ways during the meeting, and a few of the ceremonies were photographed.

Dr. Wright was presented with a silver salver engraved with the signatures of presidents of the Institute under whom he has served. Present at the President's Dinner during which the presentation was made were, left to right: R. E. Heartz, Montreal, J. B. Stirling, Montreal, A. R. Decary, Quebec, De Gaspe Beaubien, Montreal, I. P. Macnab, Halifax, C. M. Anson, Sydney, Dr. Wright, J. B. Challies, Montreal, C. J. Mackenzie, Ottawa, L. F. Grant, Kingston, J. A. Vance, V. A. McKillop, London.

Above, standing with President Anson. Dr. Wright received a complete 35-mm. camera with equipment, and purse, the retirement gift of the members of the Institute.

Above, left. A. M. Purdy and M. F. K. Leighton (right) made a presentation to Dr. Wright of an engraved lighter, a tribute from the members of the Moncton, N.B. Branch of the Institute.

Above, centre, Dr. Wright is shown with his son Meade Wright, M.E.I.C., and daughter-in-law.

Above, right. Retiring President Anson (left), Dr. Wright, and J. B. Challies, who was president in 1938 when Dr. Wright's service began.

At right. Co-workers during the entire twenty years, Miss May McLaren of Headquarters, and Dr. Wright.

Month to Month Section is continued on Page 146

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OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Lt.-Col. F. W. W. Doane, M.E.I.C., of Halifax, Canada's oldest practising engineer, and dean of engineering in Nova Scotia, died suddenly at Halifax on April 18, 1958.

Frances William Whitney Doane was born at Barrington, Nova Scotia, on May 31, 1863. He took up the practice of engineering in 1883 and for eight years was assistant to the provincial government engineer for Nova Scotia. In 1894 he was appointed city engineer for the city of Halifax. In 1900 he joined the 63rd Halifax Rifles as a lieutenant and later rose to command the battalion as colonel in 1919, retiring in 1924. He also saw active duty overseas with the 219th Battalion Nova Scotia Highland Brigade. Terminating his service with the city in 1924, he opened a private consulting practice which he conducted until 1932. He accepted work as a construction engineer with the Standard Paving Maritime Ltd. in 1932, continuing his active association with the firm up to the time of his death.

Colonel Doane was active in various engineering societies and was one of the founders of the Association of Professional Engineers of Nova Scotia as well as past president of the organization. He was a Dominion councillor of the Association representing Nova Scotia for a number of years.

Colonel Doane gave his services as lecturer at Dalhousie University on municipal and highway engineering and at the Nova Scotia Technical College on public water supplies for a number of years. He was a member of the Royal Commission on roads, 1920. He was a member of the board of examiners of provincial land surveyors.

In 1955 the Nova Scotia Technical College conferred on him the honorary degree of doctor of engineering in recognition of his accomplishments in the field of engineering and in developing the professional status of the engineer in Nova Scotia throughout a long and honoured career.

He was one of those men who pioneered in municipal engineering during the days of advancement from the horse and buggy days to modern transport systems.

Col. Doane joined the Institute as a Member in 1887, transferred to Associate Member in 1889, to Member in 1892 and attained Life Membership in 1931. The Institute named him an Honorary Member in 1952.

Lesslie R. Thomson, M.E.I.C., engineer, professor and government servant, died at Guelph, Ont., on April 27, 1958.

Lesslie Rielle Thomson was born at Toronto on January 12, 1886. Educated at the Model School, Toronto, and Upper Canada College, and the University of Toronto, he held B.A.Sc. and civil and electrical engineering degrees from the latter institution, 1906, 1907. What was to grow into a remarkable career began with appointments as lecturer and demonstrator at the University of Toronto and of Manitoba. He joined the permanent staff of the Dominion Bridge Company in 1912 and remained in this service in various capacities leading up to the post of resident engineer at Ottawa in 1918. Named secretary of the National Research Council, Ottawa, at that time, he also held the office of secretary of the lignite utilization board for a five year period. Appointed special lecturer in structural engineering, department of architecture, at McGill University in 1920, he became professor of fuel engineering eight years later. In 1924 he opened an office as consulting engineer, specializing in the fields of structural engineering and fuel economy in Montreal.

He retained his consulting engineering practice in Montreal until the outbreak of World War II. At that time he began an extensive period of government service, being appointed successively, executive assistant to the Minister of Transport, controller and secretary of the Department of Munitions and Supply, associate economic advisor and liaison officer of the same department and also of the department of reconstruction. He was also liaison officer of the government in connection with all atomic matters at home and abroad. For his war services he was awarded the O.B.E. by the Canadian Government and the Medal of Freedom with Gold Palm by the United States government, particularly for his work in connection with the development of the atomic bomb. He retired shortly after the end of World War II.

Mr. Thomson was responsible for one of the first surveys of the economics of the St. Lawrence seaway.

He was in 1926 awarded the Gzowski medal of the Engineering Institute for a paper in which he made the first public attempt to present the basic economic aspects of the Canadian Fuel Problem.

In 1938 he published a book entitled "The Canadian Railway Problem" for which he was known.

He joined the Institute as an Associate Member in 1911, transferred to Membership in 1919 and attained Life Membership in 1947.

Colonel H. G. Thompson, M.E.I.C., retired executive assistant general secretary of the Engineering Institute of Canada died suddenly on April 19, 1958, at Pickering, Ont.

Howard Grant Thompson was born at Belmont, Ontario, on August 21, 1896. He was educated at the University of Toronto where he was awarded a B.A.Sc. degree in mechanical engineering in 1922, after considerable experience with the Canadian Expeditionary Force and the R.A.F. during World War I. For several years following graduation he worked in the heating, ventilating and steam power plant field, as applied to industrial plants, particularly pulp, paper and power. These companies included the Canadian Sirocco Co. Ltd., the Roirdan Company Ltd., Temiskaming, Que., the Combustion Engineering Corporation Ltd., Toronto and Montreal, and the Affiliated Engineering Companies Ltd., Montreal. From 1932 to 1934, Colonel Thompson served on the staff of the Engineering Institute, Montreal, as editor of indices of the engineering catalogue.

In 1934 he joined Canadian Vickers Limited and was the following year appointed manager of the Toronto office of that firm.

He was selected to organize and command the first Canadian Reserve Army Field Workshop in 1937, with the rank of major and ordnance mechanical engineer. On the outbreak of war in 1939 this unit was mobilized to full strength and he was promoted to the rank of lieutenant-colonel. Major Thompson proceeded overseas with the First Canadian Division, under Gen. McNaughton. Toward the close of 1940 he was invalided home and early in 1941 was appointed chief ordnance mechanical engineer at Defence Headquarters in Ottawa with the rank of colonel.

In January 1942 he went to the Middle East as technical observer for the Canadian Army. He returned to England in a few months' time and served suc-

Lt. Col. F. W. W. Doane, M.E.I.C.

Col. H. G. Thompson, M.E.I.C.

Lesslie R. Thomson, M.E.I.C.

cessively as deputy director of ordnance engineering services and of mechanical engineering at headquarters First Canadian Army. After having supervised the formation of the Royal Canadian Electrical and Mechanical Engineers Corp., (R.C.E.M.E.), in the Canadian Army overseas, Colonel Thompson was returned to Canada in 1944 to become director of mechanical engineering at army headquarters, Ottawa, where he remained until the end of the war.

In 1945 Colonel Thompson was awarded the Medal of the Engineering Alumni of the University of Toronto, for outstanding achievement in the field of engineering. Following his retirement from the active army at the end of the war, he rejoined the active reserve in command of the workshop in the Toronto area and during this period assisted in organizing the R.C.E.M.E. Corps Association in which he served as president for the first three years.

In 1951 he was appointed to the post of assistant general secretary of the Engineering Institute of Canada. Shortly before his retirement due to ill health in 1956 he was named executive assistant general secretary of the organization.

Colonel Thompson joined the Institute as a Member in 1920, transferred to Junior Member in 1923, to Associate Member in 1928 and Member in 1940.

Brigadier Antonin Theriault, C.B.E., M.E.I.C., vice-president of Canadian Arsenals Ltd., a Quebec City, Que., Crown company, died there on March 31, 1958.

Born at Rimouski, Que., on May 10, 1887, Antonin Theriault attended the Seminaire de Rimouski, then went on to study at the Montreal Polytechnical School where in 1910 he received a B.Sc. in mining and civil engineering.

Soon after, he joined the Canadian Engineers in Ottawa, with the rank of captain. He had previously held a lieutenant's commission, since 1906, with the 85th regiment of Rimouski.

During the First World War he served in England and France and was twice mentioned in dispatches. Towards the end of the war he was attached to the War Office and also attended the Woolwich College of Science.

After the war in 1920, he was appointed chief superintendent of arsenals at Quebec and became chief superintendent in 1936. He was promoted to colonel in 1937 and to brigadier in 1942.

In World War II Brigadier Theriault was a part of the unprecedented expansion experienced by the Dominion Arsenal.

In 1946 the arsenals were re-organized into a Crown Company and Brigadier Theriault assumed the post of vice-president, held until the time of his death.

In 1944 Laval University conferred on him the degree of Doctor of Science. The United States government made him an officer of the legion of merit in 1946.

Brigadier Theriault joined the Institute as a Member in 1944.

Gil D'Aoust, M.E.I.C., plant engineer with the Powell River Company, Westview, B.C., died on February 25, 1958.

Joseph Gilbert D'Aoust was born at Vancouver, B.C. on June 14, 1905. He attended the Vancouver Technical School and the University of British Columbia, from which latter institution he graduated in 1927 with a B.A.Sc. degree in mechanical engineering. He was immediately employed as a mechanical draftsman with the B.C. Pulp and Paper Company and moved on to various short-term experience during the early nineteen thirties. He first became associated with the Powell River Company in 1934 working first as a mechanical draftsman, and three years later moving up to the post of junior engineer. In 1941 he transferred his services to Defence Industries Limited, Montreal. During the next few years he gained added experience in the service of Consolidated Paper Corporation, Port Alfred, Que., and the firm of Price Brothers and Company Limited, Riverbend, Que. In 1943 he returned to British Columbia to accept a position as mechanical engineer with the New Westminster firm of Heaps Engineering Company Limited, later with the Sorg Pulp Company, Port Mellon, B.C. In 1949 he returned to the staff of the Powell River Company as a development engineer. Promoted to senior project engineer in 1955, he became plant engineer later that year.

Recently he had served as senior project engineer on the large paper machine project completed a year ago.

Mr. D'Aoust joined the Institute as a Member in 1930, transferred to Associate Member in 1939, to Member in 1940.

A. E. Fry M.E.I.C., retired engineer with the Dominion Glass Company, Lachine, Que., died at Montreal on March 23, 1958.

Albert Edward Fry was born at Cornwall, Ont., on December 27, 1885. He received his general education in Montreal and then studied mechanical engineering with the International Correspondence Schools. Beginning his career as a machinist apprentice at Brockville, Ont., he became a machinist with the Toronto Paper Mills, Cornwall, and with the Canadian Pacific Railway at Montreal, within the next few years.

Master mechanic with the Dominion Textile Company, Montreal, in 1909, he was later with the Dominion Mahogany Veneer Company, Montreal. He undertook a number of projects for the Mooney Biscuit Company, Montreal and the Steel Corporation of Canada before joining the mechanical engineering department of Dominion Glass Company in 1920. Transferred to Montreal in 1927, he took charge of the engineering and drafting department of the firm at Pointe St. Charles. He moved to head office to take over a post in the sales department during World War II.

Mr. Fry joined the Institute as an Associate Member in 1928, transferred to Member in 1940, and attained Life Membership on January 1, 1958.

NEWS OF THE

Association and Corporation

Information received through co-operation of the provincial organizations.

Canadian Council of Professional Engineers President Elected

Professor W. O. Richmond of Vancouver, has been elected president of the 30,000 member Canadian Council of Professional Engineers, during the Council's three-day annual meeting in Vancouver. He succeeds C. N. Murray, of Sydney, N.S.

He is head of the department of mechanicial engineering at the University of British Columbia.

As president, he will head the national advisory body for Canada's eleven provincial and territorial professional engineering organizations.

A graduate in mechanicial engineering from U.B.C. in 1929, Professor Richmond received his M.Sc. from Pittsburgh University three years later. He has been associated with U.B.C. since 1937, and is also active as a consulting engineer.

He is a past-president of the B.C. Association of Professional Engineers.

QUEBEC

Engineers' Rights Protected

(Abstracted from the remarks of Premier Maurice Duplessis at the annual meeting of the C.P.E.Q., held on March 22, 1958, and reported in the May issue of the Journal)

"There is no country, on the North American continent at least, that offers as many, as good or as great opportunities as the ones offered by the Province of Quebec. The slogan of your convention is 'challenge', and God knows I always welcome a challenge, no matter where it comes from. So, the motto of your association goes to my heart and I am pleased to know that you realize more than ever the part that you have played in the past and will be called upon to play in the future towards the growth and expansion of your province.

In the province of Quebec we have built, through the work, patience, ability and assiduity of our engineers, the Bersimis enterprise, which has been appreciated by impartial experts. General McNaughton, chairman of the Canadian Section of the International Joint Commission says: 'It is evident that the responsible engineers of Hydro-Quebec, by the exercise of the highest art, have drawn an almost incredible advantage from these resources for the economic benefit of the people of Quebec and Canada. I express my admiration of the vision and the skill which they have applied and of the determination and vigour with which their plans are being driven to completion. It is indeed a great pleasure to have this opportunity to pay this most sincere tribute to the authorities of Quebec for the achievement which is Bersimis. 'Done by Quebec, by Hydro-Quebec, through engineers from the Province of Quebec.'

I am pleased tonight to be honored by your Association which has been kind enough to grant to me the title of honorary member. Your association can always rely on the government. You know, gentlemen, the prerogatives of the Province of Quebec are essential. If you want your Association to progress you've got to bear in mind that engineering is a wonderful job, engineering produces wonderful results, but the conservation and preservation of our rights in the matter of the professions is essential for the fulfillment of the destiny of our Province.

Because the Legislature of Quebec, or of Ontario, or of every other legislature, has exclusive rights in the matter of professions, and because we have these rights, you can be sure that we know our duty and that we will protect your rights and safeguard your interests."

C.P.E.Q. Golf Tournament

More than 200 golfers from the membership of the Corporation of Professional Engineers of Quebec are expected at the Grand'Mere Golf Club on Saturday, June 21, for the 5th annual Provincial Golf Tournament of the CPEQ.

Louis-George Boivin, P.Eng., of Three Rivers is chairman of the committee planning this year's tourney. Some 144 engineers teed off at the tournament last year and present indications are that at least 100 more will be out on the links this year.

New Public Relations Officer

Robert E. Martin, has been elected public relations officer of the Corporation of Professional Engineers of Quebec to succeed Norbert Prefontaine who is now engaged in immigration work.

Mr. Martin, has had experience as a newspaper man on the editorial staff of the Ottawa dailies, Le Droit and The Citizen and the Montreal Gazette. He comes to the services of the Corporation from the Ottawa Communty Chest where he was director of public relations for the fund-raising organization.

ONTARIO

Engineering Technician Meet

The first meeting of Ontario's engineering technicians and technologists was held at the Canadian National Exhibition grounds, Toronto, on May 12, when the five-hundredth engineering technician to be certified under the program established last year by the Association of Professional Engineers of Ontario received his certificate as an engineering technician, grade III, from a fellow grade II technician who had appointed an advisor to the certification board.

Dr. G. B. Langford, chairman of the meeting, discussed the function of the engineering technician certification board. Certification began in June 1957 when Premier Leslie Frost presented certificates to the first six men to qualify under a plan established by the Association of Professional Engineers of Ontario.

Professor W. O. Richmond, president of the Canadian Council of Professional Engineers, (*left*).

Robert E. Martin, public relations officer, Corporation of Professional Engineers of Quebec.

Guest speaker J. Herbert Smith, of Toronto, president of Canadian General Electric Company, declared, "Canadian industry today is spending more than $80,000,000 a year on research and development, three times more than at the end of World War II." He said that the accelerating increase in the development and research brought about by a continuing increase in population and technology pointed up the need for both professional engineers and engineering technicians.

"If we are to enjoy an increasing standard of living we can only do so by increasing our productivity. This means we have to create and innovate in the area of technology, including machines, facilities, processes and mechanisms of all kinds in order to make work less of a drudgery," he told his audience.

Mr. Smith called upon Canadians to "get busy and build here more of the manufactured products not now made in Canada," as he described the serious imbalance of trade with the United States as being due to the heavy importation of manufactured goods and components. He noted that in 1956, imports of fully manufactured goods into Canada amounted to $4.4 billions, representing a per capita figure of $273.00 of foreign manufactured goods for every man, woman and child in Canada. He compared this figure with $26.00 for the U.S.; $49.00 for Britain, $53.00 for West Germany.

"The way to correct our serious import situation," he said, "is not to change the source of import from one country to another, but for us to get busy and build here more of the manufactured products not now made in Canada. In accomplishing this, it would need the contribution of five groups, the investor, the manager, the professional engineer, the technician and the laborer." "For far too long," he said, "we have thought only of four contributors and have not included the technician as a distinct calling, quite separate from the engineer and from the laborer." Mr. Smith added that continued failure to do so will retard the tempo of our expanding economy. There must be encouragement of technicians to undertake self-development programs to fit them for the expanded opportunities and increasing complexity of our industrial life. And recognition must be provided them to bring about this encouragement." The certification program being carried out by the A.P.E.O. for engineering technicians and technologists was aimed specifically at this problem, he said.

"By granting public recognition to the technician through formal certification a clear identification of his work is established," he said.

Mr. Smith described the evolution of the engineering technician certification program which began last year when Ontario encouraged the A.P.E.O. to commence a program of recognition under the terms of the Professional Engineers' Act. He noted that the understanding was that the Association would operate the program in this manner until it had enough experience to advise the government on requirements for suitable legislation.

He pointed out that members of the Association's staff have been available to explain and discuss the certification program directly with personnel managers, chief engineers and groups of technicians.

Mr. Smith stressed that the A.P.E.O. was not attempting to make professional engineers of technicians.

The Association is using its knowledge of over 35 years to establish a group of men who work with and assist professional engineers," he said.

The Collective Bargaining Act

The Association of Professional Engineers of Ontario has recommended to the Ontario legislature's Select Committee on Labour Relations that professional engineers be excluded from participation in the Collective Bargaining Act.

In its brief signed by John A. Fox, immediate past-president and presented at Toronto on May 6 by Dr. G. B. Langford, of Toronto, the Association said it believes that "it would not be in the public interest to have members of the engineering profession included in labour legislation."

The brief referred to the fact that "members of scientific and learned professions" were excluded from the Collective Bargaining Act when it was enacted in 1943.

In asking that this exclusion be continued, the Association said it believes the majority of the employee professional engineers do not wish to be included under the provisions of the Labour Act.

"The members of the profession are required to adhere to a Code of Ethics, and it is felt that adherence to the Code and allegiance to a union might not be compatible," the brief said.

It is also noted that any strike action on the part of professional engineers would, in most instances, be directly opposed to the public interest, particularly in the utility field.

The engineers' code of ethics demands fidelity to the public, and loyalty to their employers.

The Association's brief also pointed out that it is in the public interest that Ontario together with Canada expands her export trade.

"This means new processes, new products and new forms of employment. In such a program, the professional engineer is a key figure and, as new developments are involved, he is in a confidential capacity," explains the brief. It adds that inclusion of professional engineers in labour legislation could "well weaken or restrict the full employment of technically trained professional persons in this type of development."

The Association also pointed out in the brief that it had established an employee members committee in 1956 which among other things, serves as a means of established employee groups negotiating with their employers on matters involving working conditions and salaries.

Under existing legislation in Ontario as well as in B.C., Alberta, Manitoba, Quebec, New Brunswick, Nova Scotia and Newfoundland, professional persons such as engineers, doctors, lawyers, dentists and architects are not deemed to be employees and are thus excluded from provincial labour acts.

BRITISH COLUMBIA

Discussion on Ethics

(From "What Can You Tell a Young Engineer About Ethics?", by Harold A. Bolz, associate dean, College of Engineering, Ohio State University, published in the April issue of The B.C. Professional Engineer)

"When the subject of engineering ethics was mentioned to a certain engineering student he replied, 'I expect to be a practical man, not a philosopher. As I face decisions in engineering practice, the question in my mind will be, "What is the best thing to do?" Right and wrong will be relative factors in each particular case.'

"The foundation stones of ethics may be labelled integrity, trust, consideration, and loyalty.

"Courage and integrity are prime requisites for a successful engineer. Do not continue in engineering if you are afraid to take calculated risks and to make decisions on the basis of available information, for very seldom will you be able to figure out a dead-sure answer in advance for any major engineering problem. Don't go in for engineering if you are satisfied just to 'get by'; shoddy work will not do where human lives and heavy investments are at stake. Engineers deal with the laws of nature. These are fixed and inescapable. The engineering practitioner, therefore, must be rigorously honest in thought and in action; no amount of brilliance will enable an individual dealing with such matters to ignore or to attempt to distort even the simplest laws of nature. Don't go in for engineering unless you are willing to live up to an inflexible code of integrity and honest dealing; the habit of straight thinking and honest action is just as important to an engineer as is the habit of cleanliness to a surgeon. The laws of man may be propounded, enacted, enforced and changed in accordance with the whims or expediency of the human mind. The laws of nature, however, require forthrightness and steadfastness if disaster is to be averted or the wastage of money and materials avoided. Engineering has no place for men who are merely smooth or clever. Clever argument and disputation may not be substituted for the integrity which an engineer must possess."

Personals

News of the Personal Activities of Members of the Institute

L. Austin Wright, M.E.I.C., (B.A.Sc., Toronto, 1911; D.Eng., Rose Polytechnical Institute, 1943), general secretary of the E.I.C. was elected president of the Pointe Claire Memorial Library Association, April 29, 1958. Also he was re-elected vice-president of the Canadian Arthritis and Rheumatic Society, Quebec division.

K. F. Tupper, M.E.I.C., (B.Sc., mech, Toronto, 1929; M.Sc., aeronautics, Michigan, 1938). Laval University, Quebec City, conferred on K. F. Tupper, of Toronto, president of the Engineering Institute of Canada, the honorary degree of doctor of science at a colorful ceremony during the 72nd annual meeting of the E.I.C. held at Chateau Frontenac Hotel, Quebec City.

C. M. Anson, M.E.I.C., (B.Sc., metallurgy, McGill, 1925), vice-president and general manager of the Dominion Iron and Steel Corporation Limited, immediate past-president of the Engineering Institute of Canada was conferred an honorary doctor of engineering degree on May 7. The event took place at the 49th annual assembly of the convocation of the Nova Scotia Technical College.

Colonel R. D. Harkness, M.E.I.C., (B.Sc., Queen's, 1913), president of the Northern Electric Company Limited, Montreal, was awarded an honorary LL.D. degree from Queen's University on May 17. Colonel Harkness, a trustee of that university, delivered the convocation speech for the faculty of applied science during the day's activities.

E. V. Buchanan, M.E.I.C., (A.R.T.C., Glasgow, 1908), has been awarded an honorary doctor of laws degree from the University of Western Ontario, at the annual spring convocation held May 24, 1958.

In 1957 he was appointed chairman of the Engineering Advisory Council of the University of Western Ontario.

G. A. Lowles, M.E.I.C.

P. B. MacFarlane, M.E.IC.

J. C. Hamilton, M.E.I.C.

R. L. Weldon, O.B.E., M.E.I.C. (B.Sc., mech., McGill, 1918; M.Sc., 1920), president and managing director of the Bathurst Power and Paper Company was awarded an honorary doctor of engineering at the 49th annual assembly of the convocation of Nova Scotia Technical College.

R. B. Winsor, M.E.I.C., (B.Eng., civil, McGill, 1927), of Canadian Industries Limited, Montreal, general manager of the textile fibres division, has been elected a director of the organization.

G. A. Lowles, M.E.I.C., (B.Eng., chem., McGill, 1937), of the International Nickel Company of Canada Limited, has been placed in charge of the newly opened Montreal office of the International Nickel Research and Technical Services Ltd. Since joining INCO in 1948 Mr. Lowles has been concerned with nickel and nickel alloy market developments in the petroleum, petrochemical and chemical industry throughout Canada.

Peter B. Macfarlane, M.E.I.C., (Royal Technical College, Glasgow, 1936), previously general sales manager with Atlas Asbestos Company Limited, Montreal, has been appointed vice-president and general sales manager of International Panel Boards Limited. International Panel Boards Limited, is a wholly-owned subsidiary of Atlas Asbestos.

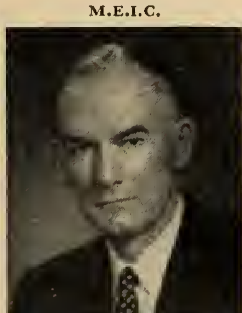
Professor J. O. Dineen, M.E.I.C., (B.Sc., elec., Toronto, 1940; M.Sc., elec., New Brunswick, 1945), of the University of New Brunswick has been named a dean of engineering. He is associated with the department of electrical engineers.

J. C. Dale, M.E.I.C., (B.Sc., elec., Alberta, 1933), president and general manager of Canadian Utilities Limited, Edmonton, has been elected a director in the organization.

John C. Hamilton, M.E.I.C., (B.Sc., chem., Queen's, 1942), vice-president, manufac-

E. V. Buchanan, M.E.I.C.

K. F. Tupper, M.E.I.C.



R. L. Weldon, M.E.I.C.

Col. R. D. Harkness, M.E.I.C.

C. M. Anson, M.E.I.C.

turing, Canadian Resins and Chemicals Limited, has been appointed to Queen's University Advisory Council on Engineering. Mr. Hamilton will represent the chemical industry on the Council's chemical engineering sub-committee in a three-year term of office commencing July 1, 1958.

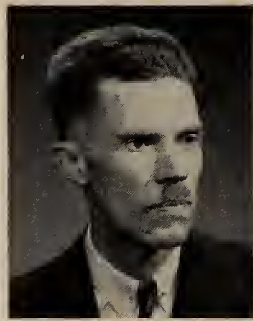
Per Hall, M.E.I.C., (B.Sc., civil, Royal Tech. Coll., Copenhagen, 1935), has been named president of the Foundation of Canada Engineering Corporation Limited. He was assistant chief engineer for the Foundation Company of Canada Ltd. from 1949 to 1953, then became vice-president of the firm he now heads.

R. E. Chadwick, M.E.I.C., (mech., Toronto, 1906), formerly chairman of the Foundation Company of Canada Limited, will continue to be associated with the company as consulting engineer. Mr. Chadwick retired from the presidency of the organization in 1952, after forty-three years service. The following year he became the first president of Foundation of Canada Engineering Corporation Limited.

F. G. Rutley, M.E.I.C. (B.A.Sc., Toronto, 1912), president of the Foundation Company of Canada Limited, at Montreal since 1952, has been named chairman of the company. He has been associated with the Foundation Company since 1914. Mr. Rutley was recently appointed Montreal regional director of the Dollar Sterling Trade Council.

R. F. Shaw, M.E.I.C., (B.Eng., civil, McGill, 1933), of the Foundation Company of Canada Limited, former vice-president in charge of special projects has been named executive vice-president of the organization. Mr. Shaw has been closely associated with many of Canada's outstanding construction projects including the building of the Eastern sector of the DEW Line.

W. E. Hickey, M.E.I.C., (B.Eng., civil, Nova Scotia Technical College, 1938), has been named vice-president and chief engineer of the Foundation Company of Canada Limited. Former vice-president of the Foundation of Canada Engineering Corporation Limited, he has been in charge of many of the company's major engineering projects.



R. C. Mitchell, M.E.I.C.

Lt. Col. D. M. Saunders, M.E.I.C.

J. S. Cooper, M.E.I.C.

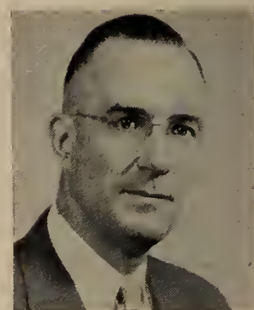
W. E. Soles, M.E.I.C., (B.Sc., mech., Queen's 1935), has been named president and general manager of the Anglo-Canadian Pulp and Paper Mills, Toronto. Mr. Soles has served the company in various capacities since 1935. He became general manager in 1952 and had been vice-president and general manager since 1954.

E. L. Ruggles, M.E.I.C., (B.Sc., civil, Sask., 1935), of the Bird-Archer Company Limited, has been appointed president of the organization. Mr. Ruggles was vice-president and general manager of the water treatment engineering firm since 1951. He joined the company in 1937 and has held responsibility in a number of positions within the firm at various centres since that time.

Warren S. Raynor, M.E.I.C., (B.Sc., mech., Queen's, 1939), of the Mathews Conveyor Company Limited, Port Hope, Ont., has been named to the post of chief engineer with the organization. A member of the staff since 1948, he has been engaged in special projects and for the last two years has been in charge of research and standards.

R. C. Mitchell, M.E.I.C., (B.A.Sc., Toronto, 1934), has been elected chairman of the Hamilton Branch of the Institute. Mr. Mitchell holds the post of manager of large rotating machine sales with the Canadian Westinghouse Company Limited in that city.

H. J. A. Chambers, M.E.I.C., (B.A.Sc., civil, Toronto, 1924; M.A.Sc., Toronto, 1925), has established the management consulting firm of Cybernetics Limited,



E. L. Ruggles, M.E.I.C.

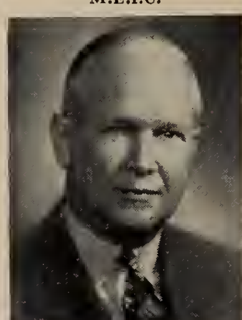
W. S. Raynor, M.E.I.C.

H. J. A. Chambers, M.E.I.C.

Per Hall, M.E.I.C.

R. E. Chadwick, M.E.I.C.

F. G. Rutley, M.E.I.C.



R. F. Shaw, M.E.I.C.

W. E. Hickey, M.E.I.C.

• PERSONALS

at Toronto. Experienced in senior engineering and management responsibilities for many years, Mr. Chambers has since 1946 been engaged in the machine tool manufacturing field and was president of Standard-Modern Tool Company Limited.

Mr. Chambers is a past-chairman and councillor of the Border Cities Branch of the E.I.C.

Lt. Colonel D. M. C. Saunders, M.E.I.C., (Royal Military College, 1939; B.Sc., civil, Queen's, 1948), of Whitehorse, Y.T., has been elected chairman of the Yukon Branch of the Institute. Commanding officer of the Northwest Highway Maintenance Establishment since 1956 Col. Saunders served with the Royal Canadian Engineers in World War II.

He became a lieutenant colonel and was assigned as assistant director of works, construction, at Army Headquarters, Ottawa, in 1953.

A. Benjamin, M.E.I.C., (B.Sc., elec., McGill, 1924), formerly head of A. Benjamin and Associates, consulting engineers of Montreal has joined the Flomen Electric Company Limited, in the capacity of vice-president. Mr. Benjamin was earlier employed with the Quebec Hydro-Electric Commission as a distribution engineer at Montreal.

C. M. Brant, M.E.I.C., (London Polytechnical, 1934), controller of radio regulations, telecommunications branch, Department of Transport, has been promoted to the newly created position of chief of technical co-ordination. Before the inclusion of Newfoundland in the Dominion of Canada, Mr. Brant, initially appointed by the U.K. ministry of civil aviation, was controller of radio (air) with the civil aviation division, Department of Transport, St. John's, Nfld.

L. P. Blaser, M.E.I.C., (B.Sc., chem., Sask., 1938), of the British American Oil Company Limited, has been appointed general manager of manufacturing with headquarters in Toronto. He joined the B.A. Oil Company in 1939 at the Calgary refinery. During the past 19 years he has held several key positions in the manufacturing department, most recently as chief engineer and previously as assistant manager of the Moose Jaw refinery.

J. S. Cooper, M.E.I.C. (B.A.Sc., civil, Toronto, 1934), assistant chief engineer with the Ontario Northland Railway, has been elected chairman of the Nipissing and Upper Ottawa Branch of the Institute.

Mr. Cooper has been active in Institute affairs as a charter member of the Sudbury branch, committeeman for the North Bay area, resident committeeman, councillor, 1956-57, and a vice-chairman of the branch in 1957.

After an extensive World War II

• PERSONALS

career with the R.C.N. he joined Ontario Northland Railway in 1945 in the capacity in which he now serves.

A. McDougall, M.E.I.C., (B.Sc., civil, Edinburgh, 1938), has relinquished his appointment as assistant project manager, Canadian British Aluminum at Baie Comeau, Que., in order to accept a position with the Vancouver firm of William Halcrow and Partners.

C. A. Leicht, M.E.I.C., of Kitchener, Ont., has been elected chairman of the E.I.C., for that region. Mr. Leicht is chief engineer with B. F. Goodrich Rubber Company of Canada Limited, and has been associated with engineering in Kitchener since 1909. He joined the Royal Flying Corps in 1916. He served with a number of companies before becoming associated with the Goodrich organization as a plant engineer in 1925.

Roy A. Phillips, M.E.I.C., (B.A.Sc., mech., British Columbia, 1939), has been appointed manager of marketing, appliance and television receiver department, with Canadian General Electric Company at Montreal. Prior to his present appointment, he was manager, marketing research and product planning in the appliance and television receiver department.

J. T. Madill, M.E.I.C., (B.Sc., elec., Alta., 1939; M.Sc., elec., M.I.T., 1940), manager of power operations B.C., of the Aluminum Company of Canada, Limited, has recently been transferred from Kitimat, B.C., to Montreal, Que. He will be assistant general manager, power division, operations, for the company.

R. R. Colpitts, M.E.I.C., (B.Eng., mech., Nova Scotia Tech. Coll., 1944), has been appointed manager of the industrial and commercial sales department of Northern Ontario Natural Gas Company Limited. He will head a department responsible for selling natural gas to large plants, mills and commercial establishments. Formerly he was in charge of industrial and commercial sales and gas utilization.

A. Butt, M.E.I.C., (B.Eng., civil, Nova Scotia Technical College, 1946), of the Imperial Oil Limited, has been transferred from Halifax to St. John's, Nfld. Mr. Butt who formerly served as operations analyst has taken on the duties of operations manager for the area.

J. B. Clarke, M.E.I.C. (B.Sc., elec., Manitoba, 1945), of the H. K. Porter Company (Canada) Limited, Federal Wire and Cable division, has been appointed general sales manager of the division. Mr. Clark joined Federal Wire and Cable in 1948. In 1950 he was assigned to the Lakehead, Manitoba, Saskatchewan and Alberta territories, as district sales manager. Mr. Clarke was appointed assistant general sales manager in 1957.

A. J. Harrison, M.E.I.C., (B.Eng., agriculture, Saskatchewan, 1950), has joined

• PERSONALS

the staff of the Edmonton firm of Petroleum Rubber Limited as sales engineer. Prior to his new appointment Mr. Harrison gained experience in construction, road building, pulp and paper, oil-field and agricultural equipment and supplies.

F. B. **Bunting**, M.E.I.C., (B.Sc., Belfast, 1949), has for a number of months been employed with the San Francisco firm of Porter, Urquhart, McCreary and O'Brien as section chief of the bridge department. Before transferring his services Mr. Bunting was a group leader with the design and construction department of the Foundation of Canada Engineering Corporation Limited at Vancouver.

Dave Pullan, JR.E.I.C., (B.Sc., engineering and business, Toronto, 1952), papers chairman for the Belleville Branch of the Institute has recently transferred to St. Catharines, Ont. He has been succeeded by Needham Throop. Mr. Pullan will be associated with American Cyanamid Ltd. at Niagara Falls.

A. D. **Cronk**, JR.E.I.C., (B.Sc., mech., B.C., 1952), is now associated with the B.C. Metals Protection Ltd., Vancouver. He will be engaged in the field of anti-corrosion protection, particularly with regards to coating and lining steel pipe. He was formerly associated with the Barrett Company Ltd.

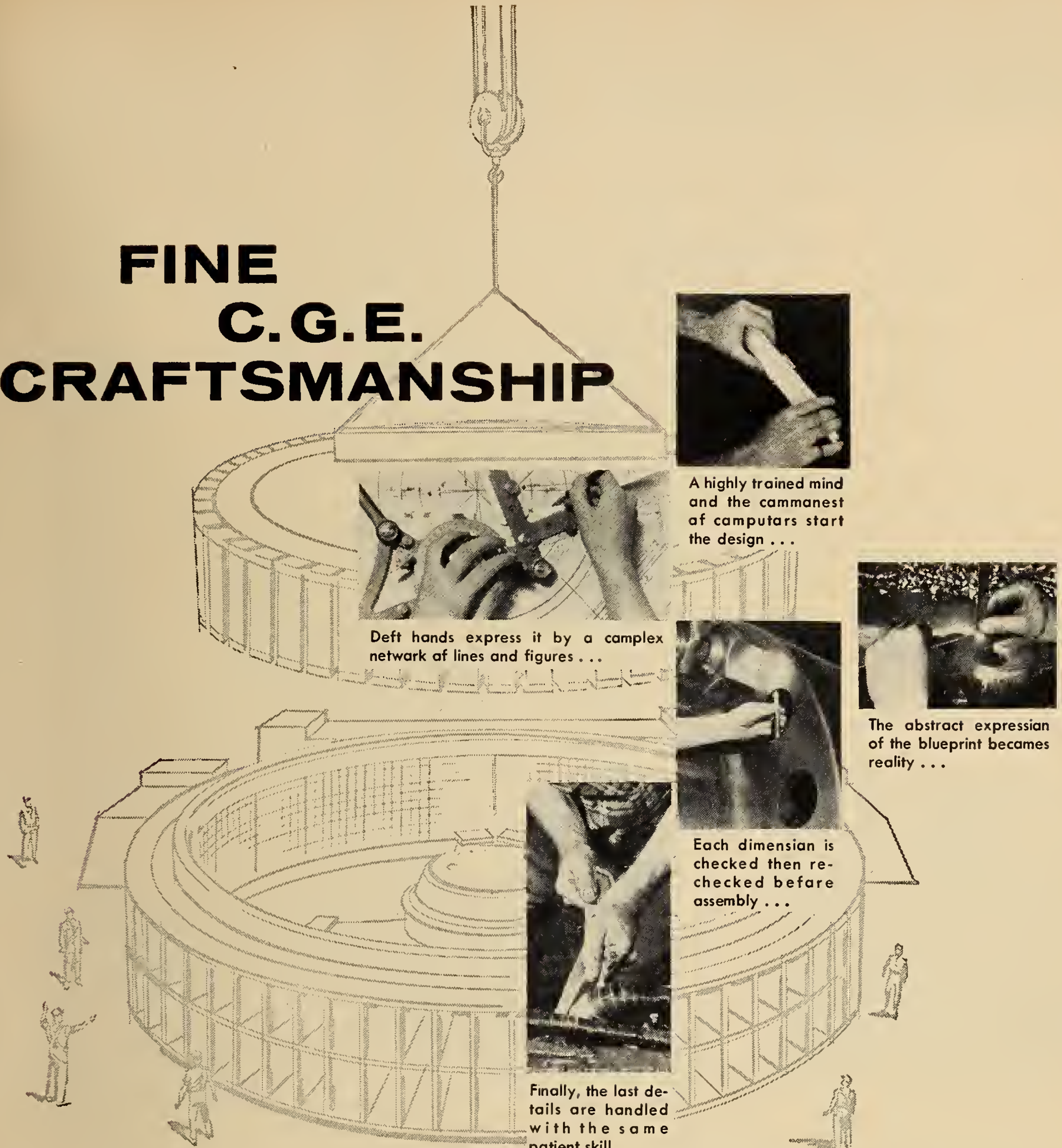
Robert I. Davis, JR.E.I.C., (B.Sc., elec., Queen's, 1949), of the Hydro-Electric Power Commission of Ontario, has been transferred from the Belleville area to Peterborough. Previously a meter engineer, East Central region, he now carries out the work of area meter engineer.

A. R. **Black**, JR.E.I.C., (B.A.Sc., Toronto, 1955), formerly employed with Sprostons Jamaica Limited, at Jamaica, B.W.I., has returned to Canada. He has accepted a position with McNamara-Brown and Root, at Pit Siding, Manitoba, on the Nelson River project.

Ray E. Jonasson, JR.E.I.C., (B.Sc., mech., Sask., 1949), of the Canadian General Electric Company Ltd., motor and control department, has been appointed district sales manager, central district, with headquarters in Toronto. With the organization since his graduation, Mr. Jonasson was most recently employed as sales representative for the motor and control department, mid-west district, with headquarters at Winnipeg.

Gerald McGurhill, JR.E.I.C., (B.Eng., chem., McGill, 1957), has left the department of Mines and Technical Surveys, Ottawa, in order to accept a position with the Montreal firm of John Struthers and Company Limited. His new post is that of chemical engineer.

FINE C.G.E. CRAFTSMANSHIP



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Sixty years ago, Canadian General Electric produced its first hydro-electric generator. That generator is still operating. Since its installation, hundreds of others have been delivered to power projects all over Canada as well as to many other parts of the world.

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Peterborough, Ont.

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NEWS OF THE BRANCHES

Activities of the Forty-Nine Branches of the Institute and abstracts of the papers presented at their meetings

BELLEVILLE

F. E. Moore, M.E.I.C., *Sec.-Treas.*

T. E. Flinn, M.E.I.C.,
Branch News Reporter.

DR. J. B. OKE, of the Dunlop Observatory, University of Toronto, on April 14 addressed the Belleville Branch on the subject of "The Chemical Composition of the Universe." The event marked the annual meeting of the Branch.

Dr. Oke described the efforts of astronomers to measure the chemical composition of the sun and the stars by making spectroscopic analyses. It has been found that the composition of sun and stars are similar — 70 percent hydrogen and 25 per cent helium by weight, with 62 other elements accounting for the balance. Helium was discovered on the sun before it was discovered on earth, hence its name, he pointed out. The region between the stars, the interstellar spaces have been investigated also. Thermonuclear reactions in the stars are constantly taking place with hydrogen being converted into helium, he said.

Election of Officers

Elected to office for the 1958-59 term were T. E. Flinn, chairman; W. Benger, vice-chairman; V. L. Lewis, E. T. Hilbig, and W. Canniff, for a two-year term on the executive; N. Throop and L. Law will serve a one-year term.

BORDER CITIES

J. M. REID, M.E.I.C., *Secretary*

A. W. MALMBERG, JR.E.I.C.,
Branch News Reporter

A JOINT DINNER MEETING of the Border Cities branch and the district membership of the Professional Engineers of Ontario was held on March 27. Among the special guests were C. T. Carson, vice-president and production manager of Hiram Walker and Sons, and president of the A.P.E.O., who addressed the meeting. Executive director Colonel T. M. Medland, B. H. Goodings, of the A.P.E.O., V. A. McKillop, past-president of the E.I.C., and Dr. Garnet T. Page, general secretary, E.I.C., were also present. In his talk president Carson said that the most important single factor in the expansion of Canada's economy in the past thirty-six years has been the rising influence of engineering. He stressed that the public is conscious of the importance of the profession because of what has been done in the past and because of a feeling of dependence on it for the maintenance of our comfortable way of life and indeed our national safety. Mr. Carson said that it is felt that an engineer is looked on as a perfectionist, and pictured as uncultured, even uncouth.

"I contend," he said, "that neither science nor applied science is far removed from culture and art." Higher education does not necessarily provide professional standing, he said. "It fails to do so unless its possessor is devoting his talents to the service of his fellow men, without undue regard to monetary rewards of such service."

Mr. Carson said that the feeling of professionalism is frequently absent in the young graduate. It comes only after a period of seasoning. But having developed that professional attitude, professional recognition must eventually follow.

BORDER CITIES: Several special guests attended a Branch meeting in March. Shown chatting are, left to right, above, V. A. McKillop, past-presiednt, E.I.C., and C. T. Carson, president of the Association of Professional Engineers of Ontario. Below left to right are: J. M. Reid, secretary, Border Cities Branch; B. H. Goodings, field representative, A.P.E.O.; V. A. McKillop, C. T. Carson, Colonel T. M. Medland, executive director, A.P.E.O.; Dr. Garnet T. Page, general secretary, E.I.C.; and C. M. Armstrong, chairman, Border Cities Branch.

EASTERN TOWNSHIPS

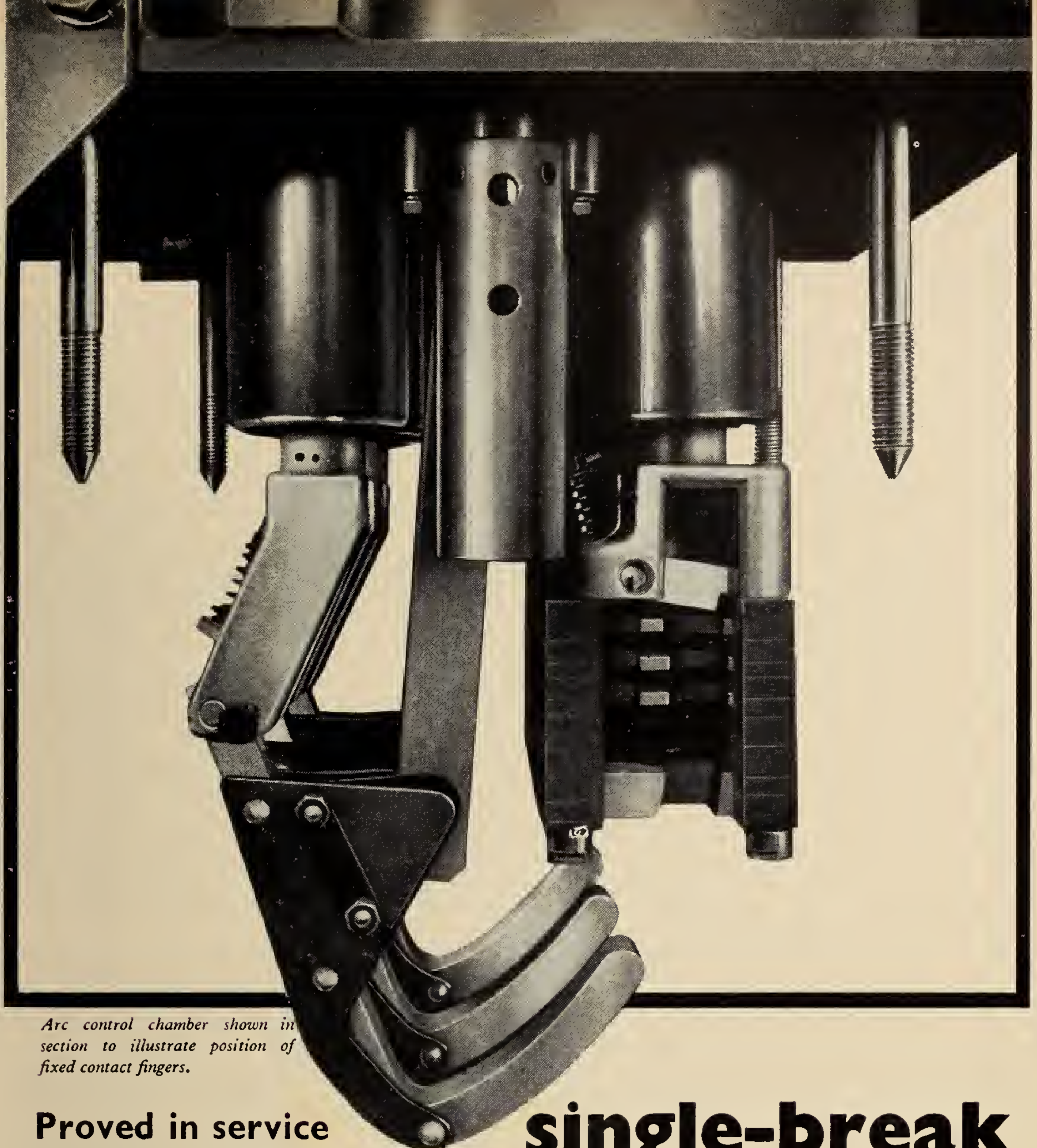
JEAN BOURASSA, JR.E.I.C., *Secretary*

THE DEW LINE was the subject of a talk by the vice-president of the Foundation Company of Canada, R. F. Shaw, at the joint meeting of the Eastern Townships Branch and the C.I.M.M. on April 11th. He described the way in which the defence project was constructed and advance parties, supplies, equipment and prefabricated buildings, landed by plane to establish campsites. Fuel, heavy equipment and structures were transported by ship during the short Arctic summer.

He added that no special problem had been experienced with the personnel as they had been carefully selected.

When asked during the question period whether the Dew Line would serve the

(Continued on page 114)



Arc control chamber shown in section to illustrate position of fixed contact fingers.

Southern Ontario Regional Conference

Above: a session of the Ontario Regional Conference. Top right: C. Climo, Niagara Falls, E. W. Hill, Hamilton, D. Hunter, Port Credit, K. F. Tupper, president-elect, E.I.C. Second from top: Mrs. H. L. Hillgartner, president, Hamilton Ladies' Auxiliary; Mr. Hillgartner, Mrs. McKillop, V. A. McKillop, immediate past-president, E.I.C., London, Ont. Centre photo: Mrs. R. Merritt, Mr. and Mrs. W. H. Craig all of Pickering, Ont.; Mr. and Mrs. F. J. Veale, Hamilton. Below: Conference committee: front row, Mrs. J. M. Skinner, R. H. Stevenson, Mrs. H. L. Hillgartner, Mrs. G. L. Poulter. Back row: J. A. Mitchell, N. Parry, J. J. Kelly, H. E. Seely, A. B. Dover, D. W. Jones. Absent, A. F. Barnard.

Bottom (left), a group of ladies enjoy the morning coffee party. Right, R. C. Mitchell, chairman, Hamilton Branch. Lower right: the conference banquet.

● BRANCH NEWS

(Continued from page 110)

purposes of defence against an I.C.B.M., Mr. Shaw stated that although it could not give protection against such weapons, it could be developed as an effective defence scheme.

FREDERICTON

A. M. Stevens, M.E.I.C., *Secretary*

J. Whiteley, S.E.I.C.,
Branch News Reporter

Three student members of the E.I.C., graduating from the University of New Brunswick this year presented their theses to the Branch at an April 14 meeting. Competing for a prize awarded by the Branch, they represented electrical, mechanical and civil engineering respectively. G. T. Phinney spoke on crib fill wharf construction as used for pier extension, at Saint John, N.B. harbour during the summer of 1957. The talk was well illustrated and showed the crib construction method of placing, filling, and pouring the final pier top.

C. T. Cheeseman's talk on the production of sulphite pulps was based on his experience during his summer work with the Fraser's Company mill at Edmundston, and outlined the handling of wood from forest to finished product.

D. M. Caughey addressed the group on drift transistors. With the Defence Research Board during vacations, he gained background material while there and used it to show how the transistor was put together, explaining its characteristics and operation.

Mr. Phinney won first prize. Consolation prizes were awarded Mr. Cheeseman and Mr. Caughey.

Election of Officers

This meeting was the annual meeting of the Branch. Officers elected for the following year were: chairman, O. I. Logue; secretary, R. D. Neal; treasurer, E. C. Garland.

An encouraging report on confederation was given by D. O. Turnbull, M.E.I.C., of Saint John, president of the Association of Professional Engineers of New Brunswick.

HALIFAX

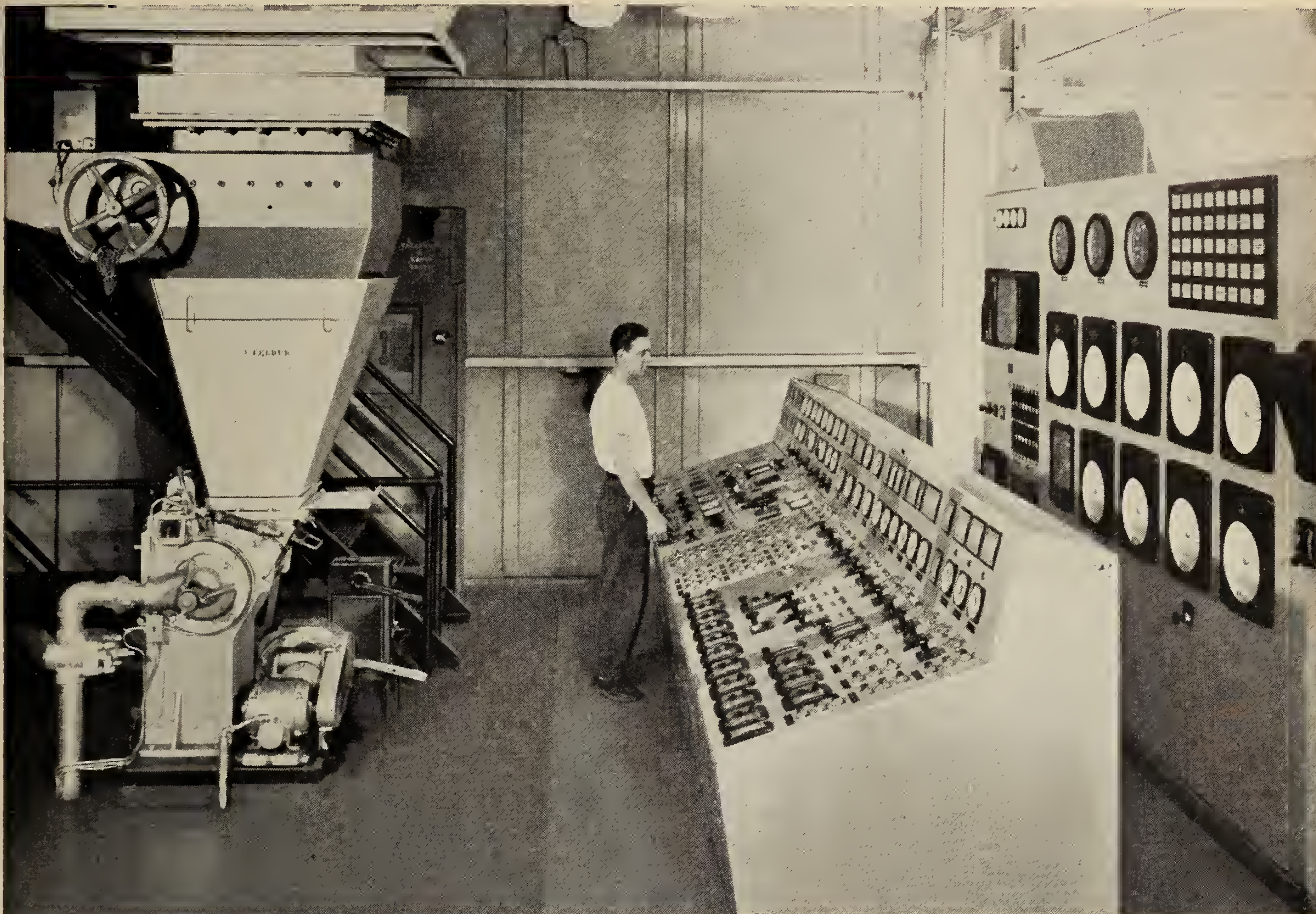
J. E. Reardon, M.E.I.C., *Sec.-Treas.*

W. J. Phillips, M.E.I.C.,
Branch News Reporter

Guided missiles and satellites was the subject of an address delivered to the Branch, March 20, by Dean D. L. Mordell of the department of mechanical engineering, McGill University.

Dean Mordell said "human travel among the planets of our system will be possible by 1993, and today's education must fit tomorrow's citizens for that kind of world, not for yesterday's." He added, "man is more than three quarters of the way to the moon in the present stage of satellite development. The range of

BAILEY Mini-line Controls



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ENGINEERS AT YOUR SERVICE FROM COAST TO COAST

operation of the air supported vehicle and the air breathing engine will be extended to the point where it will replace the expensive first and second stage rockets of the satellite vehicle."

Canada now supports fundamental research which will help make possible the needed and inevitable breakthroughs in space travel, even though at present satellite production is too expensive for any but the largest nations, he said.

Dean Mordell preferred to take a wider view than the popular one in which crash programs in education have been advocated to produce more scientists, as a solution to the problem relating to the Russian achievement with the Sputnik.

He pointed out that if the free world was regimented in a manner similar to the Russian method, it would be overcome by the sheer weight of numbers in any test of strength, whether it be military, political, or economic, he suggested.

"We live in a changing world, not a static one, and the rigid patterns of training do not fit citizens to live in such a world."

He said that today's students will be faced with problems in life of which none of us are aware. In order to train a man to think, it is absolutely necessary that he have contact with another thinker who can probe him, who can test him and expose him to new tests as he progresses.

"If we want education, therefore, we need thinkers, and these thinkers must have time to have contact with the students. In many of the universities of today, and McGill is no exception, we are falling short of our ideal targets in this direction.

In explaining the situation within the universities today he cited the case of his own faculty, in which twice the present total income per student is needed to do the job sufficiently well. Since the students pay only one third the total operating costs at present, this would mean multiplying the fees five times.

"To do the job, universities need money, and there are basically three alternatives, not mutually exclusive," he said. These were, the underwriting by the state of all expenses of the universities; increased contributions by corporations and past graduates; if a satisfactory combination of these two schemes is not soon found, then student fees must be increased. This latter step, he pointed out, would exclude many good students with small means, from the universities.

HAMILTON

W. A. H. FILER, JR.E.I.C., *Sec.-Treas.*

J. R. CURRIE, M.E.I.C.,
Branch News Reporter

ENGINEERING NEW PRODUCTS was the subject presented by Dr. R. A. Ramey, manager, new products engineering department, Westinghouse Electric Corporation at a joint meeting of the Branch with the Hamilton and Toronto Branches of the American Institute of Electrical Engineers.

Dr. Ramey introduced his subject by defining a new product as one with a new or added function. Vast expenditure are being made today for the development of new products, and the search for new products is regarded as one of management's most important duties. The need for new products is very real, Dr. Ramey stated, and emphasized the fact in prophesing that 15% of the products to be sold in 1959 would not have been available in 1955. In the last ten-year period, several companies were mentioned as having from 50 to 80% new product change.

Various charts and graphs were presented to illustrate the typical development of a new product line and various methods used by different companies to develop ideas which would lead to new products were discussed at length. One of the most important aspects of new product development discussed by Dr. Ramey was the importance of timing in new product introduction.

Dr. Ramey was introduced by Mr. G. L. Wilcox, president of Canadian Westinghouse, and thanked by R. C. Mitchell.

LONDON

W. C. Sinkins, JR.E.I.C., *Sec.-Treas.*

G. W. Chorley, M.E.I.C.,
Branch News Editor

A PANEL TYPE DISCUSSION on professional development was held on April 22, 1958 by the London Branch. R. W. McMeekin, chairman, welcomed guests to the meeting and congratulated E. V. Buchanan on receiving an honorary Doctor of Laws degree from the University of Western Ontario. This was the first time in the history of the university that an engineer has been honoured in this way. A. Furranna, M.E.I.C., was chairman of the panel which consisted of J. McLaren, field secretary. Object of the meeting was to discuss the professional development course given in London this year and to decide the nature of further courses. Opinion was registered in favour of offering fewer subjects and giving more time to each one.

NIPISSING AND UPPER OTTAWA

R. A. BOOY, JR.E.I.C., *Sec.-Treas.*

J. W. MILLAR, M.E.I.C.,
Branch News Reporter

THE ANNUAL MEETING and election of officers was held April 9.

Chairman J. F. Chantler presided. Secretary R. A. Booy announced the following officers were elected by acclamation for the ensuing year; chairman

• BRANCH NEWS

J. S. Cooper, North Bay, vice-chairman J. M. Rosborough, Temiskaming. The executive committee members with one year more to serve are J. Warburton, Temiskaming; H. Staniforth, Kiosk; and R. S. MacLennan, North Bay. Newly elected members of the executive for two years are D. Catford, Temiskaming; P. Rebin, Sturgeon Falls; and D. W. Briden, North Bay.

Retiring chairman J. F. Chantler presented his report indicating a successful year, and thanked the officers and committees for their support and co-operation, and particularly the secretary-treasurer R. A. Booy who has so conscientiously filled that position for the last two and one half years.

The treasurer's report showed a satisfactory financial condition with a larger bank balance than a year ago due to an improvement in the dues collected. Reports were presented by the committees on entertainment, papers, and membership. There are 68 members on the list, but there is a potential in the area of twice that number.

J. S. Cooper, newly elected chairman, took over the meeting and introduced the new executive. He also introduced John McLaren, Eastern field secretary, who was on tour of the northern section of Ontario. He visited members who due to distance did not find it convenient or possible to attend regular meetings of any of the branches.

Two Speakers Heard

Short talks were given by two members. The first was T. Chapman, chief engineer of Great Northern Woods, North Bay. He said that this firm manufactured bonded wood, the plant having been in operation about four years, and was the first of its kind in North America. A process had been developed by which small pieces of lumber normally unsaleable were finger pointed at the ends and edge glued to make long and wide boards of a higher grade than the original lumber. When the Russian minister of timber toured Canada in 1956, he was impressed with the process and eventually negotiated contracts whereby Great Northern Woods is to set up a smilar plant for the Russians at Archangel. Mr. Chapman spent a short time in Moscow and Archangel early in 1957. He briefly described what he had seen of the Russian people, and his impressions of their customs and mannerisms. Mr. Chapman was thanked by H. R. D. Graham.

Second speaker was D. Cullingham, shipping control chemist, Canadian International Paper Co., Temiskaming, who spoke on the simple application of statistics in evaluation of machine efficiencies. The talk was illustrated with an example from the pulp and paper industry. First he used the standard deviation formula, then the Students' T Test to assess the significance of a difference between two average values. Then he used the variance ratio of F Test to assess the significance of an apparent difference in variability.

Mr. Cullingham was thanked by Mr. R. R. Prescott.

PETERBOROUGH

G. M. LOCKE, JR.E.I.C., *Sec.-Treas.*

J. G. HOOPER, M.E.I.C.,
Publicity Chairman

THE MONTHLY SERIES of technical meetings for 1958 began in February with the discussion of the subject of "Models and Miscellaneous Marvels." The speaker, Professor L. E. Jones, associate professor of mechanical engineering at the University of Toronto has had a good deal of experience in the preparation and use of models of many different types for studying properties and performance of materials and proposed construction which can be done most readily and most economically only in this way.

Professor Jones pointed out the various types of models used in relation to engineering works with the applications of each. The five categories were display models, mechanical, abstract models used in an attempt to shape thoughts, convenience models used to reproduce hazards or test to failure without involving too great expense, imitative models, and demonstration models used to illustrate principles.

The talk was amply illustrated with slides and actual models that Professor Jones had brought with him and the easy manner of presentation made for a most enjoyable and informative evening for the members of the branch who attended.

Technical Meetings

The subject of steam turbine generators was discussed by a well-qualified team of three engineers from the Canadian General Electric Company at a March 20th meeting of the Branch. M. E. Gordon and V.L. Clarke discussed steam turbines while R. J. Gray dealt with the design of generators used in connection with steam turbines for the production of electric power. Slides were used to illustrate the paper.

Mr. Clarke began by outlining the growth in the use of steam generated power in recent years. Whereas the chief source of power, until recent years, was water-driven turbine generators, at present close to 50% of generation is from steam driven turbines. Hydro-electrical generation is expected to continue at about the same rate of development as at present but will only be able to supply about half the expected needs. For some years steam turbines are expected to drive the generators supplying most other requirements.

Most of the problems that make steam turbine design differ are the control of steam temperature and heat dissipation. Distortion of the casings during warm-

up and cooling are critical and the capacity of units is limited by the amount of steam that can be passed through.

Mr. Gordon detailed the problems and techniques relating to lubricating and control systems. He stated that these matters are in the process of continuous development. Protection devices are important and the goal is to keep them as simple as possible. At present they are mechanical.

Mr. Gray indicated the peculiar problems involved in the design of generators for use with steam turbine drive. Cooling, again, is a big factor. Hydrogen gas cooled generators up to 200,000 KVA are being produced. Liquid coolant of either oil or water-type has been developed successfully to permit installations up to 450,000 KVA.

After starting up a new installation the first shut-down for inspection usually is after six months. Following inspections and maintenance are at about three-year intervals. Down time in then about one month.

Vaino Aare, a designer of hydro-generator units, thanked the speakers.

Branch Plans

A large number of the executive of the Peterborough Branch are from the civilian atomic power department of the Canadian General Electric Company. For this reason, it is expected that the Peterborough Branch will hear plenty of news of atomic energy this year. It is expected that a group of the local branch will visit the NRU reactor in Chalk River, Ont.

The local executive of the Peterborough Branch have expressed the desire to become amalgamated with some of the American Societies such as the A.S.M.E., the A.I.E.E. and the A.S.C.E.

The branch has adopted the custom of inviting non-member engineers to the technical meetings in the hope of interesting them in membership in the Institute. A program for membership under the direction of Vaino Aare is underway. It is hoped that ten or 15 new members will be enrolled from the very potential Peterborough area.

SASKATCHEWAN

R. BING-WO, M.E.I.C., *Sec.-Treas.*

G. E. PADBURY, M.E.I.C.,
Branch News Reporter

THE SASKATCHEWAN BRANCH held a successful dinner meeting on April 28, 1958 at Regina. A committee of four, namely J. C. Traynor, R. J. Genereux, R. Harry, and L. Sirret was nominated to appoint an executive for the Regina section of the Branch.

Guest speaker, George R. Stewart, M.E.I.C., reservoir engineer, of the Imperial Oil Limited, was introduced by J. Crate before his talk, entitled the "Steelman Oil Field."

The Steelman oil field extends over two townships (80 acre spacing). It is located in the southeast corner of Saskatchewan, 20 miles east of Estevan in the Midale zone, between Carnduff and Weyburn. The oil reservoir is of the Mississippian, about twenty to thirty feet thick. Oil is trapped between dense anhydrites at a depth of between 4,500 to 4900 feet. The porosity is equivalent to a sandstone. The product is 34 to 40 degree light gravity oil with a gas in solution of 700 cubic feet per barrel, which is quite high. There are 550 wells. The wells are easy to complete, since there is not gas above the oil reservoir and no water below the reservoir. Some wells are capable of producing over 100 barrels per day, however they are held down to 70 barrels per day by government regulations. The productivity of a well varies with the permeability of the oil reservoir.

Three methods of obtaining oil were outlined. 1) gas cap drive by gas pressure above the oil reservoir, 2) water drive by water pressure under the oil reservoir, 3) dissolved gas drive by the gas in the oil reservoir.

Steelman oil field has been depleted approximately 5% and a pressure decline and gas oil ratio increase is predicted. An average well is predicted to produce about 200,000 barrels of crude oil. With this in mind, a secondary recovery pressure maintenance is being investigated, that is, to add energy to supplement or replace original energy. This can be done by various methods, but is usually obtained by the following methods: 1) combustion, 2) gas injection, 3) water drive.

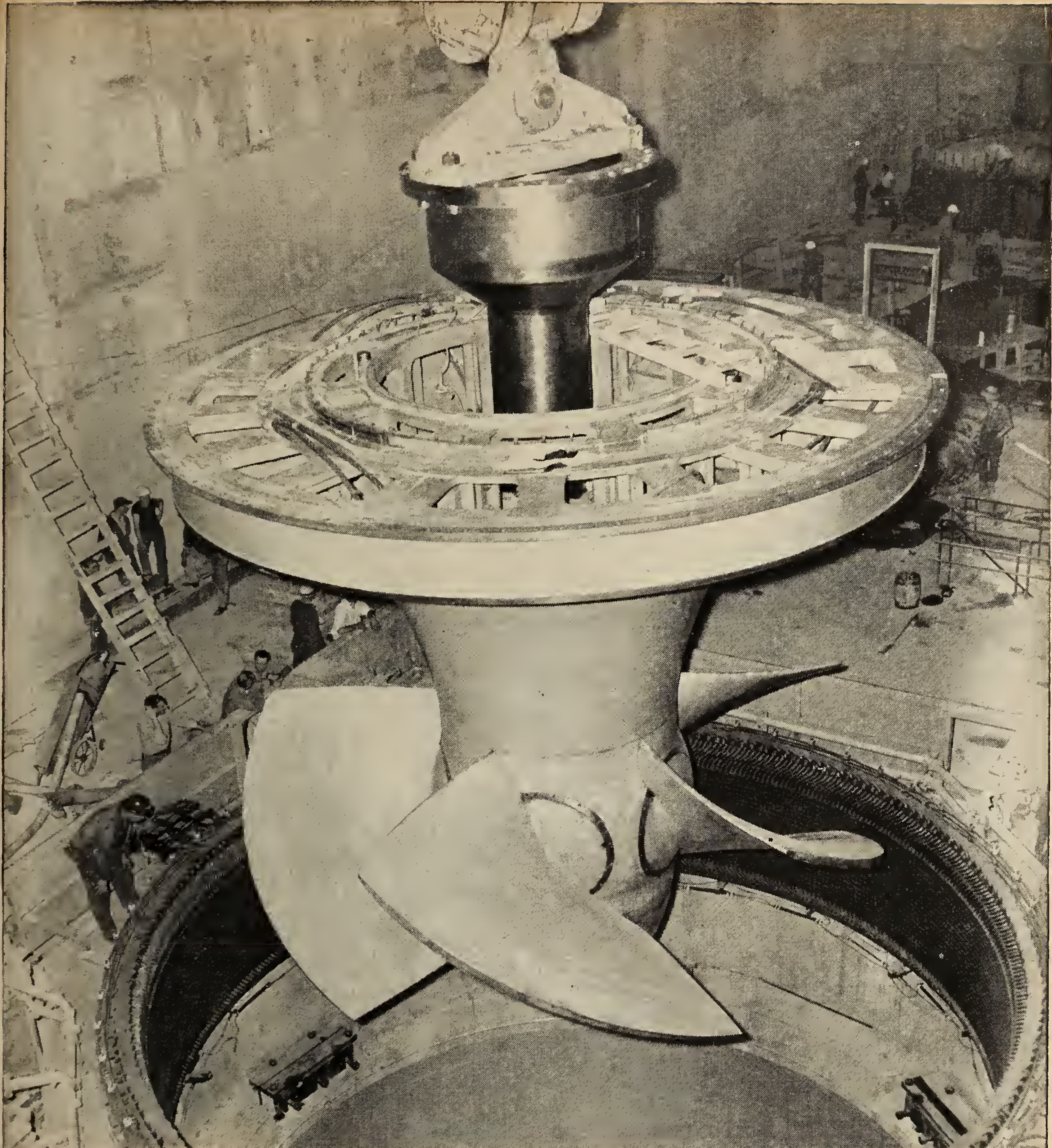
SUDBURY

W. J. Ripley, Jr., JR.E.I.C., *Sec.-Treas.*

M. D. Head, M.E.I.C.,
Branch News Reporter

TWENTY-EIGHT MEMBERS and guests attended the annual general meeting of the Sudbury Branch. After the minutes of the last meeting had been read, chairman J. Smith reviewed the activities of the branch over the past year. Statements or reports were presented by W. J. Ripley, Jr., secretary-treasurer, and by committee chairmen: R. Crawford, papers and publicity; C. Knight, for A. Finlayson, attendance; and Roy Smith, education. Other business included: discussion of branch representation in the separate technical branches of the Institute; an error pointed out by R. Moore, in the printed by-laws of the Branch, concerning the number of executive committee members.

Elected to office for the following year are: W. B. Ibbotson, chairman;



DOMINION KAPLAN TURBINES FOR BEECHWOOD

One of the 45,000 H.P. hydraulic turbine runners being lowered into position at the New Brunswick Electric Power Commission Beechwood power station on the St. John River.

Delegates to the World Power Conference Sectional Meeting, Sept. 1958 in Montreal, are welcome to visit our plant.

DOMINION ENGINEERING
COMPANY LIMITED, Montreal, Canada

E. M. Powell, vice-chairman; H. W. Whittles, resident committeeman; and Bruce Russell, non-resident committeeman. Following his election as chairman Mr. Ibbotson took the chair. To conclude the meeting R. Crawford presented a film entitled "The Pursuit of Wisdom," which was supplied by the University of Toronto.

Counselling

Recent activities of the Branch included arrangements for speakers to address senior high school students on the advantages of careers in engineering. Twelve schools in the greater Sudbury area, including Espanola, Corriston and Capreol, have, or will be visited for this purpose.

TORONTO

D. S. MOYER, M.E.I.C., *Sec.-Treas.*

GORDON F. R. NORTON, JR.E.I.C., *Branch News Reporter*

KON PIEKARSKI, M.E.I.C., of Toronto delivered a talk on "Education and Industrial Progress in Japan," at a March 27 meeting of the branch. The talk was based on a trip to that country.

Mr. Piekarski said that his Canadian attitude that all items produced by the Japanese are flimsy and cheap in price because Japan is a backward country, was unfounded.

Since his work had been in the field of solving production problems by automation methods, it was with surprise that he found himself watching the operation of a new machine which until that moment was merely an "idea" awaiting a Canadian owner's dubious "go ahead."

Strange to Canadian businessmen would be the big industry, classed as reliable, against small industry, as "not reliable."

Correspondence with Japanese is frustrating, for the Japanese businessman feels it more polite not to reply to a letter than to send an answer of "no." Japanese industry does not believe in sales promotion, trading companies act as the sales organization, both at home and abroad. The attitude seems to be to produce a useful item of quality and buyers will come. Mr. Piekarski felt that the Japanese system was superior.

Many production foremen are university graduates; many are employed in quality control and research programs of industry. A graduate engineer is highly respected, and there exists a greater incentive for higher education. Poorly equipped Tokyo university is able to accept only one out of every six applicants.

A sound and colour film produced in Japan showed Japanese industrial development. A massive hydro-electric project, producing electricity to power machines, to mine coal, which in turn is used to produce more electricity by firing huge steam plants, was dealt with. Many phases of modern life in Japan were shown, including electric commuter trains, household appliances, television and radio sets, modern buildings and factories. The highly mechanized shipbuilding industry, now the largest producer of ships in the world, was also seen.

Present also to answer questions were three Japanese guests representing trade, government and industry.

Labour unions are very active. The textile industry is 99% union, and affiliated with the U.S.A. Factory labour is cheaper, the administrative personnel is four times the ratio of this country. Labour is not anxious to become management, as is the case in this country. The number of workers exceeds the available jobs, with the result that the worker is more conscientious and more productive than the Canadian counterpart.

There are no typewriters and the 4000 symbols used in writing must be done by hand.

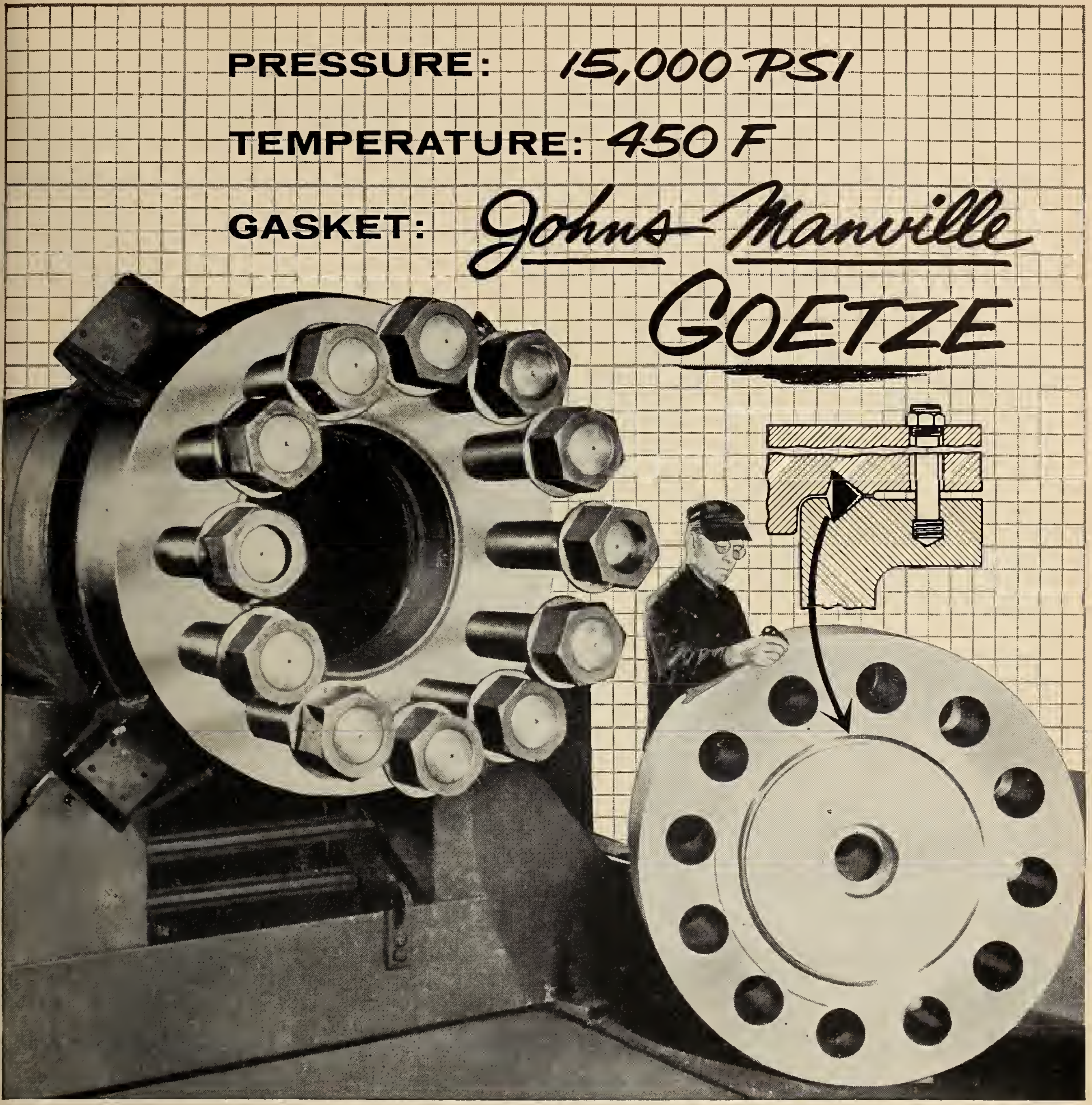
Canadian wheat sales to Japan in 1957 totalled 139 million dollars; the latter selling goods to us to the value of only 61.5 million dollars. Faced with this imbalance of trade, Japan looks to Canadian markets in the hope that, given a chance, Japanese manufactured goods can compete. Mr. Piekarski felt that Canadians could realize a saving by importing such items as custom built automatic machines and electronic equipment from Japan.

YUKON

CAPTAIN R. I. CROUSE, JR.E.I.C., *Secretary*

THE ANNUAL MEETING of the Yukon Branch which took the form of a dinner-dance took place on March 28, at Whitehorse Inn ballroom. Nineteen couples enjoyed cocktails, dinner and dancing. Toward the close of the evening retiring chairman Captain S. Thomson introduced the new members of the Branch executive. They are: chairman, Lt. Col. D. M. C. Saunders; secretary, J. Phelps; treasurer, John Scott. Following the introduction of the new executive, Captain Thomson commented briefly on the activities of 1957, which unfortunately were not as extensive as he had wished. This was due to the long periods of absence from Whitehorse of Captain Thomson and the secretary because of the failure of the Peace River Bridge.

Brigadier J. R. B. Jones, D.S.O., O.B.E., C.D., gave a vote of thanks to the committee for their work during the year.



How A. O. Smith maintains tight seals in giant "Multi-Layer" vessels

Today's tremendous pressures and temperatures have placed special demands on manufacturers of processing equipment. A. O. Smith has answered this need with a special type of "Multi-Layer" vessel construction. And Johns-Manville in turn has provided gaskets that assure tight seals under these exacting conditions. Typical of these is the delta type gasket, illustrated above, which was designed, for this application, to withstand pressures up to 15,000 psi. and temperatures to 500 F.

The development of special gaskets to meet special purposes has been the stock in trade of Johns-Manville's Goetze division for more than sixty-five years. Expert technicians possess a knowledge of metals and other factors related to gasket design and performance that is unmatched in the field. What's more, intensive specialization and modern production tooling provide substantial cost savings on J-M gaskets.

If you need gaskets for high pressure vessels for similar applications, send us a drawing or template for quotation. If you have a sealing problem of any kind, J-M technicians will work directly with your own engineers to develop new gaskets —or adapt existing styles—to meet your specific requirements. Write for further information to Canadian Johns-Manville, 565 Lakeshore Road E., Port Credit, Ontario.

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JOHNS-MANVILLE JM PRODUCTS **Johns-Manville PACKINGS & GASKETS**

News of Other Societies

C.G.R.A. Staff Changes

Changes in the staff of the Canadian Good Roads Association, necessitated by expansion in its technical program, are announced by G. W. Gilchrist, its managing director.

Gordon D. Campbell, formerly engineer-observer at the site of the road test project currently being conducted by the American Association of State Highway Officials, has been appointed director of technical services. Rowland Ian Kingham will replace Dr. Campbell as the Association's observer on the scene of the $22 million test at Ottawa, Ill.

As director of technical services, Dr. Campbell will work with the seven C.G.R.A. technical committees and assist in planning and carrying out their work programs. He will act as secretary of the advisory committee on technical information, and of the A.A.S.H.O. Road Test committee, and in addition, will maintain a technical information service at the Association's Ottawa headquarters.

Mr. Kingham, who is on leave of absence from the Highways Division of the Federal Department of Public Works, will be assigned to the test road to study and report on every phase of the comprehensive tests. His activities will complement and facilitate the work of the C.G.R.A. Illinois Observer Committee.

C.G.R.A. participation in the A.A.S.H.O. Test enables Canadian legislators, administrators, contractors and other professional groups and individuals to keep informed of all developments and conclusions of this significant project.

Engineering Applications of Automation

The British Group for Engineering Applications of Automation of the British Conference on Automation and Computation, has been formed.

The study of the techniques, machines, and concepts of automation, automatic control and computation has been intensified in Great Britain during recent years arousing interest in all branches of science and industry. A result of this is an organization known as the British Conference on Automation and Computation, which seeks to facilitate the exchange of information regarding the activities of the individual societies within the whole subject. The decsion to set up this conference was taken in April 1957.

This new organization has been divided into three groups;
A— The British Group for the Engineering Applications of Automation; B— the British Group for Computation and Automatic Control; C— the British Group for the Sociological and Economic Aspects of Automation Techniques. Group B was formally constituted in December, 1957.

The Engineering Applications Group was formally constituted in February, 1958, with 21 engineering societies associating themselves with the Group. Its aims are to foster the development of the engineering applications of automation; to afford a common meeting ground for the adhering organizations, whereby such of their activities as fall with the purview of the Group can, if so desired, be co-ordinated and extended; to maintain, as may be desirable, liaison with other Groups of the British Conference on Automation and Computation by direct contact and by representation on the general committee of the British Conference; to encourage and, if desired, to co-ordinate the presentation, at international conferences, of British papers whose subjects fall within the purview of the group; through the general committee of the British Conference on Automation and Computation, to maintain, as may be desirable, liaison with the corresponding national committees of other countries which support such international conferences.

The constitution of the Engineering Applications Group provides for the election of additional member societies.

Dr. D. F. Galloway, a member of the Council of the Institution of Mechanical Engineers, is chairman of the group. The secretarial services are provided by I.M.E., the honorary secretary being Brian G. Robbins, secretary of I.M.E. Correspondence should be directed to the honorary secretary, B.C.A.C., at 1, Birdcage Walk, Westminster, London.

Reports

C.C.A. Makes Recommendations

The Canadian Construction Association presented to the Federal Cabinet, in May, policy statements and resolutions adopted earlier at the Association's annual meeting.

The submission, made May 8, was signed by H. J. Ball, president of the organization and S. D. C. Chutter, its general manager.

Roughly three-quarters of the resolutions and statements adopted at the convention were addressed at least in part to the federal government. It was therefore essential that clear cut agreements be reached on these financial matters by the various governments in order to permit long-term planning of construction problems.

So much of the Canadian economy relies on the construction program that any sizable reduction in its volume would not only adversely affect the industry itself but also the general public.

The 1958 volume of construction will amount to approximately $7.1 billion.

Construction since 1945 has amounted to 13 per cent of Canada's gross national product. This proportion has risen roughly 21 per cent so that now one in every five dollars spent in end goods and services is a construction dollar; a dollar spent in fixed assets for an expanded future economy. There are two basic and related problems that have concerned the Assoc.: 1) the expansion of the industry's capacity in order to be able to carry out efficiently and economically larger and more complex construction programs and 2) the adoption of measures that will stimulate the demand for construction so that the potentially greater volumes ahead may be attained.

The submission presents the C.C.A. stand on the questions of housing, highways, tendering practices, labour relations, taxation and tariffs

C.I.G.R.E.

The 17th biennial session of C.I.G.R.E. (International Conference on Large Electric Systems) was held at Paris, June 4-14. Chairman of the Canadian Committee was E. V. Leipoldt of Montreal.

Attended by delegates from 50 countries these conferences are devoted to the discussion of technical problems of large high voltage transmission systems.

• OTHER SOCIETIES

Recent developments were discussed in the fields the design and operation of alternators, transformers, and circuit breakers; construction and operation of overhead lines and underground cables; tion of extra high voltage transmission of networks; the construction and operation of extra high voltage tarnsmission lines.

Four Canadian papers were presented at the conference.

Symposium on Ice Bearing Strength

A symposium on the bearing strength of ice, sponsored by the Associate Committee on Soil and Snow Mechanics of the National Research Council, was held at the Building Research Centre, N.R.C., April 16 and 17, 1958.

Eight papers dealing with the technical aspect of the bearing strength of ice were presented and discussed. These papers included field observations on the elastic properties and ultimate strength of ice. Consideration was given to special problems such as loading on the edge of an open crack.

C.S.A. Annual Meeting

The thirty-first annual meeting of the Canadian Standards Association was held at the Fort Garry Hotel, Winnipeg, May 30, 1958. Many representatives of the 500 technical committees of the organization were present.

C.S.A. standards were explained by President Dr. J. M. Thomson, as a broad field, and as specific applications. There are national standards for dimension and definition, for testing and performance and for safety. They are prepared by committees in which a balance of producer and consumer interest is maintained, with consideration given to representation on a nation-wide basis, in order to provide a standard that may be accepted throughout the country.

Dr. Thomson urged reduction of waste in manufacturing and raising of productivity through widespread use and development of national standards. This meant, he explained, wholesale use of the standards now available, and an accelerated program for developing the standards needed.

Dr. Thomson said that there is still no limit to the number of standards required and now is the time to develop co-ordinated standards in the rapidly advancing fields of technology.

We must also plan our standards in advance so that their use is co-ordinated from the raw materials to the finished article. He said that a special plea was being made to Canadian industry to help build a comprehensive, integrated set of national standards now when they are so vitally needed.

● OTHER SOCIETIES

Guest speaker at the luncheon meeting was Walter R. McLachlan, executive vice-president, administration and co-ordination, A. V. Roe Canada Ltd.

American Concrete Institute

The session on structural design of the 54th annual convention of the American Concrete Institute in Chicago was a joint session with the structural division of the American Society of Civil Engineers, which was holding its mid-west convention at the same time in Chicago. Topics on concrete structural design of interest to members of both societies were featured.

Another session, sponsored by A.C.I. Committee 215, included five reports concerned with fatigue of concrete.

A third session was devoted to construction technology, including descriptions of two recent outstanding projects, a discussion of control of concrete mixes on a large highway project, and a historical survey of failures with lessons to be learned from them.

Douglas McHenry, Portland Cement Association, and Joseph W. Kelly, University of California, were named president and vice-president of the American Concrete Institute.

Notices

National Water Safety Week

This summer the Canadian Red Cross Society will make a determined effort to reduce Canada's annual drowning toll in a campaign to be inaugurated by the second National Water Safety Week, June 15-21.

American Institute of Industrial Engineers

The Research Information Committee of the A.I.I.E. is endeavouring to secure abstracts of research performed in the period, July 1, 1952 to July 1, 1957. Sources from which information is solicitated are universities, industrial organizations, research institutions, and non-profit organizations including government agencies and professional societies. The committee has indicated that it will appreciate all information on industrial engineering research, past and present. Write Research Information Committee, A.I.E.E., Dept. Industrial Engineering, Washington University, St. Louis, Mo.

Nuclear Research Available

The latest nuclear research in the application of atomic energy to the engineering industry will be presented at the 1958 International Conference on the Peaceful Uses of Atomic Energy to be held in Geneva, 1-13 September 1958.

The Document Service of The Chronicle of United Nations Activities has inaugurated a complete service to supply the engineering industry with materials on the Conference. Available immediately are the lists of papers to be presented, including several hundred dealing with engineering research throughout the world.

Topics covered include reactor technology, plans for construction of nuclear power plants, properties of reactor materials, radiation effects on materials, use of isotopes in industrial technology, and hazards involved in disposal of radioactive products.

The lists may be obtained free by writing to: Engineering Document Service, The Chronicle of United Nations Activities, 234 West 26 St., New York 1, N.Y.

Calendar

Canadian Construction Association

C.C.A. National Housing Conference, Construction House, 151 O'Connor St., Ottawa, (C.C.A. h.q.), June 18-19.

Commission Generale d'organization Scientifique

International Congress, Brussels, June 25-28. Organized by CEGOS, 33 rue Jean-Goujon, Paris (8e).

International Union of Testing and Research Laboratories for Materials and Structures

Symposium on iron-frame for ferro-concrete and on iron-frame of pre-stressed concrete, Liege, Belgium, July 3-5.

Group for the Study of Atoms and Molecules from Radio-Electric Research

Annual colloquium on resonances, Paris, France, July 7-11.

Technical Association of the Pulp and Paper Industry

Seventh statistical course of the Canadian Pulp and Paper Association, Quebec City, Que., July 7-18.

Technical Association of the Pulp and Paper Association

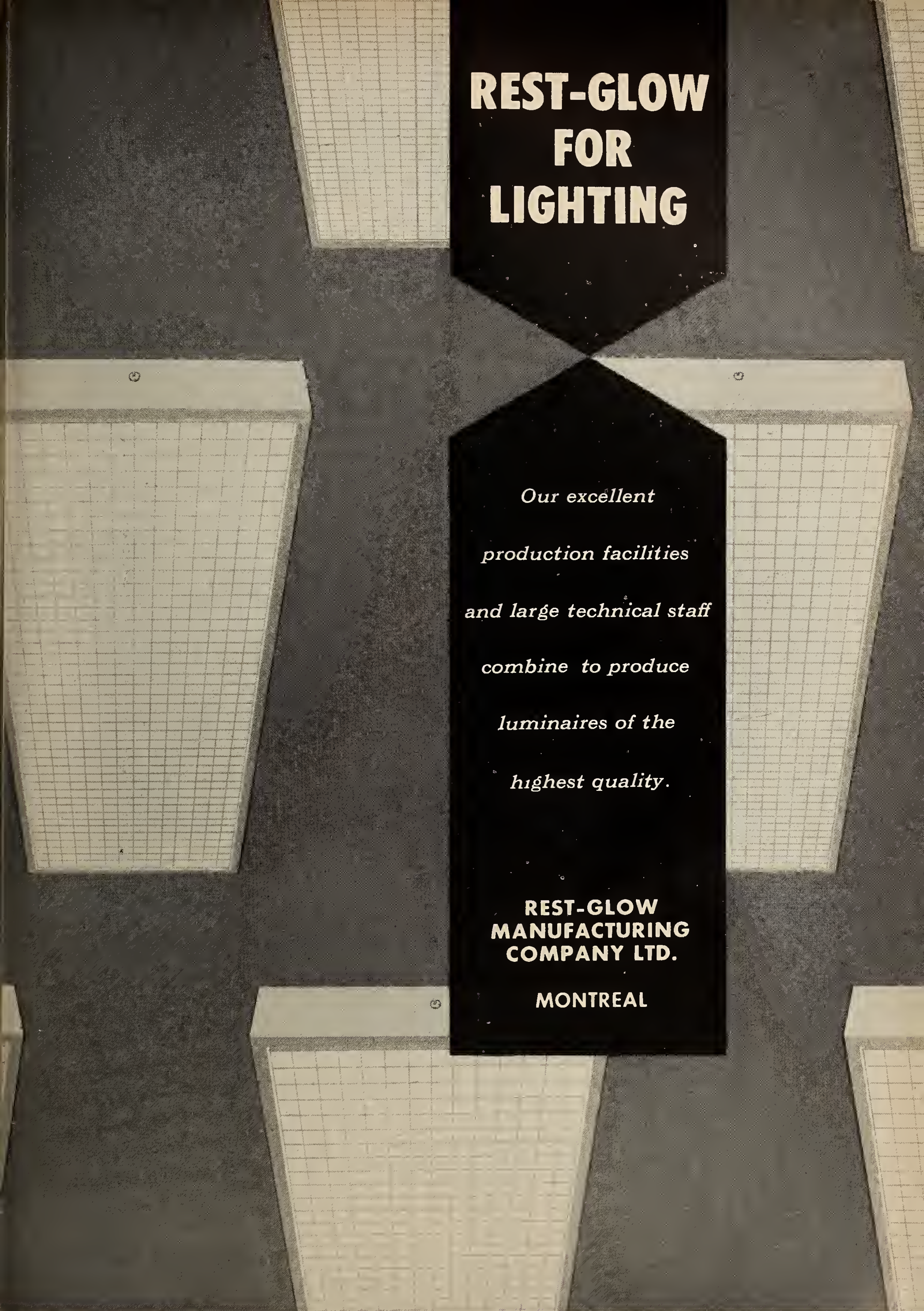
Thirteenth Engineering Conference, Portland, Ore., July 28-Aug. 1.

Institute of Aeronautical Sciences

National Summer Meeting, Ambassador Hotel, Los Angeles, Calif., July 8-11. Write: I.A.S., 2 East 64th St., New York 21, N.Y.

Canadian Electrical Association

The sixty-eighth annual convention of the Canadian Electrical Association, Banff Springs Hotel, Banff, Alta., June 30-July 2. Write: managing director, Rm. 320.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BOOK REVIEW

IRRIGATION AND HYDRAULIC DESIGN, VOL. II, IRRIGATION WORKS

According to the author, this book is to be considered a handbook for the practical designer of hydraulic works, with special emphasis on the irrigation aspect. This is no doubt true, but in the opinion of this reviewer, it would be much more appreciated by engineers working in India or Egypt where conditions, both physical and economic, are much different from those in America.

The use of this volume by Canadian engineers, as a handbook, would be awkward and to some extent impractical; however, it is instructive and refreshing as supplementary reading. It shows clearly the differences in approach to the design of irrigation projects existing between American practice and that of Egypt and India.

Volume 11 begins with chapter 4 on the design of regulators (called "checks" in Canada). The hydraulic theory presented is elementary, the presentation very clear, with all the mathematical steps being painstakingly shown. The most uninitiated can follow the arguments, but the coefficients in the equations are based mostly on the metric system of measurement. This makes reading difficult for the Canadian, since one had to mentally convert to foot units in order to appreciate or grasp the implications.

A large number of empirical formulae are used in the sections on design. This is where one realizes the differences between the old world and the new, so far as irrigation engineering is concerned. The old world has centuries of experience in irrigation, and many rule-of-thumb formulae have accumulated. Some of these may not be too scientific, but are still standing the test of time. It should not be forgotten, also, that these traditional designs and construction methods are based on a plentiful supply of cheap labour.

In India and Egypt particularly, masonry is still largely used in the construction of hydraulic structures. This leads to a massive type of structure, which depends largely upon sheer weight for stability. Labor costs for such structures in Canada would be prohibitive; if indeed their construction would be possible, in view of the scarcity of stone masons these days. The author does, however, add a short section in each chapter in which he briefly describes American practice, and how it differs from that in Egypt, where his experience was apparently obtained.

It appears that the main difference in the design of hydraulic structures between the old world and the new, is in the provision for uplift. In Canada, an upstream cutoff wall of necessary depth is invariably provided, followed immediately by complete under-drainage of the structure. In Egypt and India, on the other hand, little use is made of vertical cutoff walls and/or drainage, except in large structures. An extremely heavy structure is merely set on the ground, the 'creep' line being almost exclusively horizontal. Another objection to this type of structure in Canada, in addition to the economic one mentioned earlier, is the frost problem. It is feared that undrained masonry floors and walls would not last long in our sub-zero weather.

Chapters 5 and 6 deal with the design of inverted siphons and weirs. Included is a section on sand and silt excluders and extractors, which is instructive. Sand and silt has always been a serious problem in the river delta irrigation projects in India and Egypt. This problem is almost non-existent on our table-land projects in Canada, but occasions may arise when a knowledge of preventive or corrective measures in this regard would be useful.

Chapter 7 deals with the layout and design of canals and distribution systems. Here, the procedures outlined in this volume come closer to our own. Differences in climate, crops grown, and soil conditions cause natural departures, but the principles underlying the procedures are the same.

Soil conditions in the delta countries require canal velocities to be set at about two-thirds of the values used in our Canadian glacial drift. On the other hand, it is interesting to note that canal capacities for a given acreage are about the same in Egypt as those being currently designed in Canada.

Chapter 8 covers the design of the bridges, aqueducts (flumes) and gates. The section on bridge design is quite detailed, and covers timber, steel and reinforced concrete types. There is also a lengthy section on the design of moveable bridges.

In general, the material in the book is very well presented. Explanations are painstakingly made, the English is good, and the impression of this reviewer is that the author knows what he is talking about. It is important however, that the Canadian user of this book keep in mind the experience background of the author, and how it differs from Canadian and United States practice. (Serge Leliavsky. London, Chapman and Hall, Toronto, Ryerson, 1957. 864p., $60.00.)

W. L. Foss, M.E.I.C.

THE ENGINEERING INSTITUTE LIBRARY

The publications mentioned in these Notes are now available in the Library. Members of the Institute may borrow books, periodicals, pamphlets, etc. from the Library. The loan period is two weeks, excluding time in transit, and two items may be borrowed at one time. Library hours are: Monday to Friday: 9 a.m. — 5 p.m.

Because of a recent change in policy, publications (except periodicals published by other engineering societies) may no longer be purchased through the Library. If members have difficulty obtaining material locally, it is suggested they write to the Library, and the enquiry will be forwarded to an appropriate bookseller. For further information write to the Librarian.

BOOK NOTES

Prepared by the Library, The Engineering Institute of Canada

*ANALYTICAL KINEMATICS OF PLANE MOTION MECHANISMS

Vector methods are used throughout this text to define the concepts of motion. Aspects discussed include the nature of motion transfer, displacement and loci, velocities and mechanisms, properties and transfer of accelerators, cams and cam mechanisms, and gears and gearing. (J. Huckert. Toronto, Brett-Macmillan, 1958. 209p., $7.75.)

WILEY BOOKS

AIRCRAFT AND MISSILE PROPULSION

By M. J. ZUCROW, Purdue University

The first volume of an important new three-volume work is now ready. Designed to give you a better understanding of the fundamental principles governing the functioning and operating characteristics of engines used to propel winged aircraft and missiles, both guided and unguided, at high speeds. Special features help you follow the subject matter with ease. *Volume I* discusses the thermodynamics of fluid flow and its application to propulsion engines.

VOLUME I

Thermodynamics of Fluid Flow and Application to Propulsion Engines. 1958. 538 pages. Illus. $11.50.

NETWORK SYNTHESIS, VOLUME I

By DAVID F. TUTTLE, Stanford University

A comprehensive, highly readable treatment of the most important ideas used in the synthesis of networks. This first volume of a two-volume work covers the two-terminal (one-port) network or one-terminal pair. Features a three-step procedure: — obtaining a working knowledge of the properties of networks; investigating ways of approximating desired behaviour; and carrying out the actual synthesis of networks to achieve such attainable ends. 1958. 1176 pages. Illus. $23.50.

PRINCIPLES OF NOISE

By J. J. FREEMAN, University of Maryland

Makes you familiar with enough of the principles, facts, and techniques used in noise analysis to enable you to read the literature and use it as a professional tool. Deals with such topics as probability, stationary random processes, and their transformation, power spectra, noise temperature, input signal-to-noise ratio, output signal-to-noise ratio, minimum detectable signal, etc. 1958. 299 pages. Illus. $9.25.

SWITCHING CIRCUITS AND LOGICAL DESIGN

By SAMUEL H. CALDWELL, Massachusetts Institute of Technology

A clear and practical presentation of fundamental principles which gives a better understanding of the complexities involved in the design of switching circuits. Deals with the methods used to handle the problems of circuit synthesis using various kinds of components, and enables you to create your own methods for handling new problems. 1958. 685 pages. Illus. $14.00.

NOTES ON ANALOG-DIGITAL CONVERSION TECHNIQUES

Prepared by Staff Members of the M.I.T. Servomechanisms Laboratory, ALFRED K. SUSSKIND, M.I.T., editor

Based on the 1957 M.I.T. Special Summer Program on Analog-Digital Conversion Techniques. Coverage includes: an introduction to the theory of sampling, quantizing, and coding; detailed analysis and evaluation of basic coding and decoding methods for electrical and mechanical analog quantities; and a case study showing how basic principles were applied in a digital flight-test instrumentation system. 1958. 417 pages. Illus. $10.00.

PROGRESS IN SEMICONDUCTORS, VOLUME II

Edited by ALAN F. GIBSON, Radar Research Establishment, Malvern, U.K.; P. AIGRAIN, Université de Paris; and R. E. BURGESS, University of British Columbia

The latest information on important aspects of semiconductor research by 13 top authorities. 1957. 280 pages. Illus. $10.50.

AIR CONDITIONING AND REFRIGERATION

By the late WILLIAM H. SEVERNS and JULIAN R. FELLOWS, both of the University of Illinois

Clear, useful descriptions of the devices employed in the control of air conditioning, with a discussion of the problems involved in specific types of plants. The broad coverage includes such topics as thermodynamics, fluid mechanics, combustion, and fuel selection. Examples of typical calculations are included. Based on the second edition of *Heating, Ventilating, and Air Conditioning Fundamentals* by the same authors. 1958. 563 pages. Illus. $10.25.

QUEUES, INVENTORIES AND MAINTENANCE

The Analysis of Operational Systems with Variable Demand and Supply

By PHILIP M. MORSE, Massachusetts Institute of Technology

Shows you how to analyze and solve problems involving maintenance and inventory by the application of the queuing theory. Gives a general description of the subject, defines terms, outlines analytic aspects of the theory, and discusses the effect of changes of arrival and service distributions on queuing results. Helps you set up your own model to fit your particular operation, and to compute your own formulas. The first volume in a new series, *Publications in Operation Research,* sponsored by the Operations Research Society of America. 1958. 202 pages. $6.50.

INSTALLING ELECTRONIC DATA PROCESSING SYSTEMS

By RICHARD G. CANNING, University of California, Los Angeles

A practical guide with a realistic approach to such key topics as planning the installation program, programming, installation, conversion to the EDP system, and the early phases of operation. Tells you how to organize the EDP section, select its personnel, the number and type of people needed, the total cost, auditing procedures for protection against fraud and errors, and how to operate during the conversion period. 1957. 193 pages. Illus. $6.00.

MOTION AND TIME STUDY, FOURTH EDITION

By RALPH M. BARNES, University of California, Los Angeles

Almost completely rewritten to bring you the best and most modern theory and practice. Contains new material on: developments in the industrial use of pulse rate as an index of physical activity; statistical procedures in time study; auditing of methods, time standards, and wage incentive plans, *plus* complete coverage of Work Sampling, and important background information on electronic processing equipment. 1958. 665 pages. Illus. $9.25.

BORON, CALCIUM, COLUMBIUM AND ZIRCONIUM IN IRON AND STEEL

By R. A. GRANGE, United States Steel Corporation; F. J. SHORTSLEEVE, D. C. HILTY, W. O. BINDER, all of the Electro Metallurgical Company, G. T. MOTOCK, Olin Mathieson Chemical Corporation, and C. M. OFFENHAUER, the Electro Metallurgical Company

A concise summary of all the available data on four of the important alloying metals for iron and steel. Complete, accurate information, some of it for the first time in published form. The fourth publication in the *Alloys of Iron Research New Monograph Series: Frank T. Sisco, Director.* 1957. 533 pages. Illus. $14.00.

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*BASIC MOTION TIMESTUDY

Provides the principles of work measurement and motion identification necessary for the establishment of a system of predetermined motion times that has as its goal universal application. The present volume differs from similar studies by its use of "basic motion" which emphasizes clear-cut end points that may be applied to all body members. Practical procedures and examples are given. (G. W. Bailey and R. Presgrave. Toronto, McGraw-Hill, 1958. 195p., $5.00.)

*GRAIN BOUNDARIES IN METALS

A study of grain boundaries in metals which attempts to correlate and classify the basic problems involved. It includes a great deal of numerical data useful in approaching the subject. Starting with theories about the structure of grain boundaries and their influence on microstructure, diffusion, fracture and behavior during plastic deformation, the book then continues with energies of grain boundaries, migration of boundaries, and special features of low angle boundaries. (D. McLean. Toronto, Oxford University Press, 1957. 346p., $7.50.)

*THE GRAY IRON CASTINGS HANDBOOK

Provides information useful in the design, purchase, and applications of gray, ductile, white, and high alloy iron castings. Data is given on design: specifying and purchasing; properties; heat treatment in relation to improved wear resistance and strength; welding, joining and cutting; machining and grinding; abrasive finishing; metallic and non-metallic coatings. (Edited by C. F. Walton. Cleveland, Gray Iron Founders Society, 1958. 607p., $10.00.)

HEATING VENTILATING AIR CONDITIONING GUIDE, 1958

This thirty-sixth and largest edition of the Guide has again been brought up-to-date, and extensive revisions and additions made in many of the chapters. Some of the changes include the addition of a description and design method for high velocity air duct systems; an enlarged section on the heating pump; a simplified presentation of industrial drying principles; more information on heavy fuel oils; a revision of the chapter on radiators; and an enlarged section on air cleaners.

The Technical Data section is divided into seven sections: fundamentals; human reactions; heating and cooling loads; combustion and consumption of fuels; systems and equipment; special systems; instruments and codes. The catalogue section has also been enlarged, and the data in it revised. Both sections are well indexed. (New York, American Society of Heating and Air Conditioning Engineers, 1958. 1272+503p., $12.00.)

HUMAN ENGINEERING

A study of the adaptation for human use of work equipment, work space and environment, and consumer products. Topics included are illumination, visual displays, color, atmospheric conditions, arrangement of equipment, and the design and arrangement of controls. In addition several chapters deal with various aspects of the human organism and the way in which motor activities are carried out. (E. J. McCormick. Toronto, McGraw-Hill, 1957. 467p., $9.60.)

INDUSTRIAL CONTROL CIRCUITS

This text is concerned primarily with control circuits found most often in industrial electronics, where they form the basis of the regulation and control of many industrial processes. It is intended for those who have little knowledge of the field.

Considered are: electronic relay control and timing circuits; photoelectric control; power controls; control circuits for gaseous and vapour filled tubes; electronic d-c motor control; welding control; and industrial instrumentation control. Various specific industrial applications are described, and the book is illustrated with diagrams and photographs. (Sidney Platt, New York, Rider, 1958. 194p., $3.90.)

*INFLUENCE LINES FOR CONTINUOUS BEAMS

A series of three reports, each dealing respectively with two, three, and four span structures. Each report contains tables providing influence line data for continuous beams of constant moment of inertia. Influence lines for special points are developed, thus providing the data to investigate the occurrence of maximum positive moments under several conditions. Unsymmetrical cases are investigated and provide data of value in economic studies. (W. C. Boyer and J. I. Abrams. Baltimore, Johns Hopkins Press, 1958. Various pagings, $10.00.)

*INTRODUCTION AU GENIE NUCLEAIRE
VOLUME I: PHYSIQUE ET CALCUL DES RÉACTEURS NUCLÉAIRES.
VOLUME II: CONTROLE ET PROTECTION DES RÉACTEURS NUCLÉAIRES.

Vol. I of this two-volume set covers the fundamentals of nuclear physics, the basic theory of nuclear reactors, and the design and calculations of several types of reactors including brief discussion of one Russian installation. Vol. II deals with reactor control, and with the detection of radiation, radiation danger, and protection. A brief treatment of the liberation of energy from the fusion of light elements is appended. (T. Kahan and M. Gauzit. Paris, Dunod, 1957. 388 and 396p., 3,900fr. ea.)

*LIVING WITH THE SUN, VOL. I

Sixty plans selected from entries in the 1957 international architectural competion to design a solar heated residence. Two principal solutions to the design of solar energy units are utilized. In the first the solar collectors are assumed to be an integral part of the house, while in the second the heat-collecting mechanism is kept as a separate entity. Design notes offer an explanation of the design and proposed method of operation, with an indication of the estimated heat loss

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

• LIBRARY NOTES

and gain. (Phoenix, Arizona, Association for Applied Solar Energy, 1958. X11p., 60 plans, $6.00.)

*LA MECANIQUE DES ROCHES

The author presents, for the civil engineer, a treatise on the mechanical behavior of rocks and rocky terrain comparable to the numerous works on soil mechanics. In the first two sections he deals with theoretical aspects and experimental data. The third section covers applications: drilling and excavation work; foundations; tunnel supports and linings, and other aspects of tunneling related to underground conditions; cementation and sealing. Much information is given in tabular and graphic form and a considerable bibliography is appended. (J. Talobre. Dunod, Paris, 1957. 444p., 4800 fr.)

*MIRACLE BRIDGE AT MACKINAC

The story of the construction of the Mackinac bridge is told by the engineer who designed it, David B. Steinman. Purely technical factors have been avoided in the writing, but the reader is given an indication of the myriad of problems that were encountered in building the longest, costliest and safest suspension bridge in the world. Some of the difficulties faced are revealed by its center span which is 3800 feet long, towers which are 552 feet above the water and cables that are two feet in diameter. The story of its creation is a tribute to its engineer. Mr. Steinman is a member of The Engineering Institute of Canada. (Grand Rapids, Wm. B. Eerdmans, 1957. 208p., $4.50.)

*THE NAVAL ARCHITECTURE OF SMALL CRAFT

Concerned primarily with the design of working boats; inshore and middleground fishing vessels; patrol, pilot and customs launches; high speed craft. Consideration is given to such factors as stability and rolling, course keeping and dryness, rudders, frictional resistance and fouling, wave making resistance and hull form, installation and transmission of power, propeller design, and powering calculations. Also included is a discussion of sail and power yachts. (D. Phillips-Birt. New York, Philosophical Library, 1957. 344p., $15.00.)

NEW SOURCES OF ENERGY AND ECONOMIC DEVELOPMENT

This report was prepared by the Secretary-General of the United Nations in collaboration with five specialists.

The first part consists of a comparative study of the five new sources of energy; solar, tidal, wind, geothermic, and the thermal energy of the seas. It reviews the methods developed to control and use these energy sources, it considers their main characteristics, and examines the ways in which they might be used to produce electric power, and other uses to which they might be put. Finally, lines of future development are considered.

The second section comprises five studies on the five energy sources, abstracted from the papers prepared by the specialists. The final part of the report is an annotated bibliography of almost 500 items. (United Nations, Secretary-General. Toronto, Ryerson, 1957. 150p., $1.25.)

°ONCE ROUND THE SUN: THE STORY OF THE INTERNATIONAL GEOPHYSICAL YEAR

Because of the importance of the sun in the study of geophysics, various phases of the sun's behavior are discussed and its effects on the earth, including earthquakes, terrestrial magnetism, and the movements of the oceans and the great air masses, the auroras, and the melting of glaciers. The program of the International Geophysical Year is covered in detail: the 24 hour watch on the sun, the oceanographic program and the concentration of stations throughout the earth. A two-page conclusion is a summary of what the program hopes to achieve. (R. Fraser. London, Hodder and Stoughton, 1957. 160p., $3.95.)

PLASTICS PROGRESS, 1957

The eighteen papers in this volume were presented in an abridged form at the 1957 British Plastics Convention, and cover some of the most recent international advances in plastics technology. The discussions which took place at the meetings are included.

The authors are leading authorities on the subject from the United Kingdom, the United States and Germany, and much of the information in the papers is based on original work which has not previously been published. The subjects covered include polyolefins, polythenes, polyvinyl chloride, polystyrenes, reinforced plastics, fluorine polymers, and current developments in the theory and practice of extrusion and injection moulding. (Ed. by Philip Morgan. London, Iliffe, Toronto, British Book Service, 1958. 394p., $10.00.)

POWER SYSTEM COMMUNICATIONS

Based on a series of advanced lectures at the Heriot-Watt College in Edinburgh, this is the third volume to deal with a particular aspect of power system operation. The first two volumes dealt with power system transients, and power system plant, while this book covers communications, a specialized branch of the subject, a knowledge of which is, however, essential to the power engineer.

The different chapters are written by experts and cover communication circuits; various types of apparatus such as relays, switches and transformers: post office plant, including telephone and telegraph; carrier-current equipment; radio and television equipment, supervisory remote control; telemetering; and intertripping.

Some of the chapters include bibliographic references. This should prove a useful volume in an interesting series. (Ed. by E. O. Taylor, Toronto, British Book Service, 1957. 340p., $7.50.)

°LA PROPULSION PAR FUSEES

A thorough treatment of the theory and practice of rocket propulsion. The beginning chapters deal with the general aspects of energy production, propulsion tube theory, and the characteristics of rocket motors. The characteristics, manipulation, and combustion of both solid and liquid propellants are next considered in detail, including the fuel systems. Both low and high frequency instability of combustion are treated, and the last three chapters are devoted to the exterior ballistics of rockets. (M. Barrère and others. Paris, Dunod, 1957. 389p., 5600fr.)

RADIO AMATEUR'S HANDBOOK 1958

Now in its thirty-fifth edition, the Handbook has once again been brought up-to-date, and new equipment in all categories appears throughout the book. Both simple and complex designs are described in the chapter on receiver construction, and the transmitter section contains information for both the beginner

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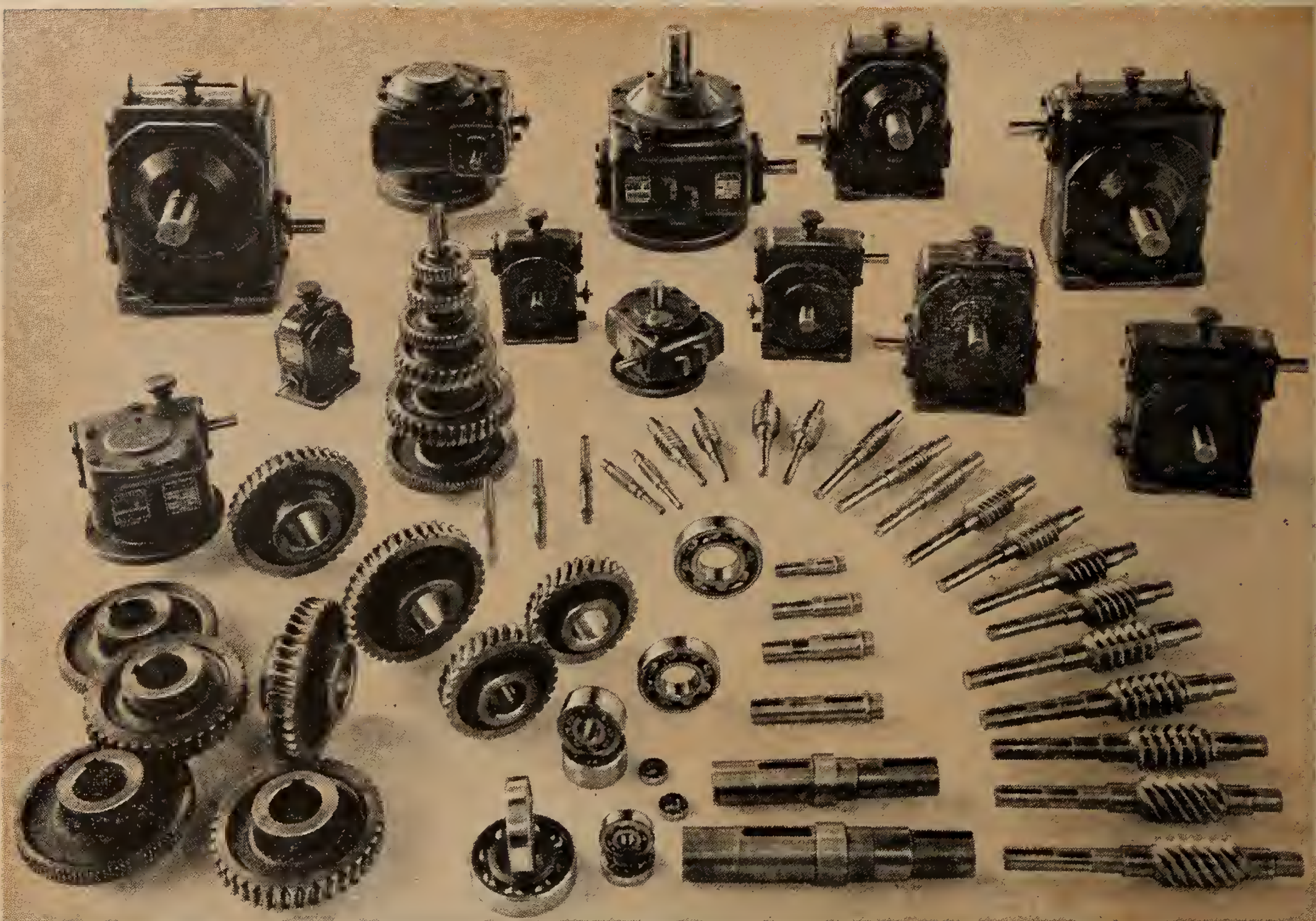

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and the expert. High powered amplifiers and beam antennas have been added to the v.h.f. sections, and material has been added on radioteletype machines and circuits. There are the usual sections on basic theory, including one on semiconductors, and a large catalogue section. (West Hartford, Conn., American Radio Relay League, 1958. 746p., $4.00.)

RUSSIAN-ENGLISH GLOSSARY OF ELECTRONICS AND PHYSICS

One of a series of eight interim glossaries being published by the Consultants Bureau during the compilation of its comprehensive Russian-English Physics Dictionary, this particular volume lists terms in electronics, including idioms and a certain amount of general vocabulary. The terms are taken from seven Russian journals translated by the Bureau, and an appendix covers U.S.-Soviet vacuum tube equivalents, unit equivalents, circuit components and notations, and abbreviations.

The glossary is reproduced by multilith process from varityped copy, and is very easy to read.

The other seven glossaries, the first two of which are already available, will cover the fields of nuclear physics and engineering, solid state; electricity and magnetism; liquids and hydraulics; acoustics and shock waves; mechanics and general physics; atomic physics, spectroscopy and optics.

The Bureau is to be highly commended for the work it is doing in making available translations of Russian journals. (Ed. by P. Robeson, Jr. New York, Consultants Bureau, 1957. 343p., mimeog., $10.00.)

*THE SCIENTIFIC PAPERS OF SIR GEOFFREY INGRAM TAYLOR, VOLUME I: MECHANICS OF SOLIDS

This volume, which is the first in a series of four, contains all of Taylor's papers on elasticity, plasticity, the properties of metals, and dislocation theory. A number of studies prepared for government agencies are now made generally available for the first time. The three other volumes will be devoted to papers on the mechanics of fluids. (Ed. by G. K. Batchelor. Toronto, Macmillan, 1958. 593p., $12.75.)

SCIENTIFIC RUSSIAN

The recent intense interest in Soviet science has shown how few English-speaking scientists have any knowledge of the Russian language, and has emphasized how great the need is for those who can read it.

The author of this text realized many years ago the growing importance of Russian, learnt it himself, and published this book in 1950.

The purpose of the book is to teach a reading knowledge of scientific and technical Russian, and it is intended for class-room use, for self-study and for reference.

The text is divided into forty lessons, each devoted to some grammatical point. The reading exercises all discuss some scientific topic, for example vitamins, atomic energy, radar, etc. The emphasis throughout is on learning to read scientific literature, and once the initial difficulty presented by the strange appearance of the Russian alphabet is overcome, a careful, and continuous, study of this text should enable the reader to master ordinary technical articles. (J. W. Perry. New York, Interscience, 1950. 816p., $7.50.)

*SEMINAR ON WIND TUNNEL TECHNIQUES AND AERODYNAMICS

The papers of this seminar, held in Stockholm, May 1954, cover many aspects of the subject including the design and use of sonic and supersonic wind tunnels, strain gage balances, electronic apparatus, flow around various types of wings drag and air intakes. Swedish wind tunnels are described, and a final paper discusses the financial background and organization of aeronautical research and development in Sweden. (Stockholm, Royal Institute of Technology, 1955. Various pagings. Price not given.)

• LIBRARY NOTES

THE SOURCES OF INVENTION

This is a study of the inventions of the nineteenth and twentieth centuries their origins and effects. The authors discuss the inventor working on his own, research done for industry, and the development of inventions.

The information in the volume was obtained from scientists, technologists, patent lawyers, financiers and research administrators, and throws some light on various questions being discussed at present. What contributions are being made by the research departments of large corporations, and is this to be the main source of future inventions? Is it possible to predict the type of inventions and to control technological progress? Does a monopoly in industry encourage invention?

The second part of the book consists of brief case histories of some fifty inventions from automatic transmissions to zip fasteners, and including such things as cinerama, cyclotron, gyro-compass, Kodakchrome, radar, synthetic detergents and transistors. (John Jewkes, David Sawers, Richard Stillerman. Toronto, Macmillan, 1957. 428p., $6.25.)

SPECTROCHEMICAL ABSTRACTS, VOL. 5

The two hundred and fifty abstracts in this volume are for the years 1952-53, and cover emission spectroscopy in its analytical applications, including flame spectroscopy, but not X-ray emission spectroscopy.

The abstracts themselves are arranged by subject, while the source of the abstract is given in the author index. There is also an index of elements observed as minor constituents of samples.

It is hoped to publish the volume covering 1954-55 later in the year. (Ed. by E. H. S. van Someren and F. Lachman. London, Hilger and Watts, 1958. 66p., 20/-.)

SPRINGS: A BIBLIOGRAPHY

The entries in this bibliography are arranged chronologically, and cover the period 1678 to 1956. Until 1927 the references are listed alphabetically by author, but after this date they are arranged according to the subject headings used in the Engineering Index.

The references and annotations have been taken from: ASM Review of Metal Literature; ASME Research Publication; Chemical Abstracts; Engineering Index; Industrial Arts Index; Metallurgical Abstracts.

The bibliography has been compiled by the Research Committee of the Associated Spring Corporation. (Hamilton, Wallace Barnes Co., 1957. 386p., mimeog.)

*SYMPOSIUM ON DETERMINATION OF DISSOLVED OXYGEN IN WATER

This collection of five papers deals with current procedure for the determination of the concentration of dissolved oxygen in water, including both the manual spot-check methods and those using instruments providing continuous indication and record. The principle advantages and disadvantages of various procedures and apparatus are studied, and the conditions under which each can most appropriately be applied is indicated. Methods presented include polarographic measurement, the Beckman analyzer, the Hartman and Braun recorder for boiler feedwater, and the Cambridge analyzer. (Philadelphia, American Society for Testing Materials, 1958. 59p., $2.25. (S.t.p. no. 219)

*SYMPOSIUM ON INSULATING OILS

The two papers presented are: valuation of laboratory tests as indicators of the service life of uninhibited electrical insulating oils; the use of solid and liquid catalysts for the accelerated aging testing of transformer oil. They are concerned with insulating oil for use in transformers and related electrical equipment, with particular reference to the need for adequate test methods to evaluate new oils, oils in service, and reclaimed oils. (Philadelphia, American Society for Testing Materials, 1957. 39p., $1.75. (S.t.p. no. 218)

*SYMPOSIUM ON NONDESTRUCTIVE TESTING

Papers discussing the latest and most widely used techniques of nondestructive testing and their application to materials

inspection. Techniques discussed include radiographic testing, magnetic particle and penetrant testing, and ultrasonic testing. (Philadelphia, American Society for Testing Materials, 1957. 99p., $2.75. (S.t.p. no. 213.)

°SYMPOSIUM ON RAILROAD MATERIALS; LUBRICATING OILS

Seventeen papers on lubricating oils, cleaning compounds, fuels, and nondestructive testing methods. About one half of the papers deal with these materials in relation to diesel engines. (Philadelphia, American Society for Testing Materials. 169p., $4.50 (S.t.p. no. 214.)

°SYMPOSIUM ON TITANIUM

Papers on testing techniques and effects of various heat treatments on the properties and characteristics of titanium and titanium alloys. (Philadelphia, American Society for Testing Materials, 1957. 208p., $4.75. (S.t.p. no. 204.)

TELECOMMUNICATION ECONOMICS

This volume is intended primarily for telecommunication engineers, but the methods suggested will be of interest to other utility organizations. The author points out in his Preface that although much has been written on engineering economics and their application to commercial enterprises, their application to public utility plant engineering has not been widely investigated. In the text he shows how the same general principles can be applied to this field, especially when planning large utility schemes.

The author, who has had many years planning experience with the British Post Office which operates the telephone system, describes many of the factors and procedures applicable to the economic engineering of a telephone system, including sufficient information for working out cost studies. The factors include: interest and present value; depreciation; service life of equipment; economics of automatic telephone exchange systems; future requirements; replacement studies; the costs of exchange equipment; economics of traffic routing; automatic equipment in rural areas.

Mr. Morgan shows how to approach the question which is corollary to "Can we do it?" that is "Can we afford it?" (T. J. Morgan. London, Macdonald, 1958. 452p., 50/-.)

TRAFFIC TRANSIT PARKING: METROPOLITAN WINNIPEG; A REPORT

In common with every other city in Canada, Winnipeg has had its traffic problems.

This is the report of a comprehensive traffic and transportation survey of the Winnipeg Metropolitan area including the following: vehicle origin, destination, and parking needs; traffic movement; public transportation users; traffic counts downtown; travel time studies and traffic signal operation.

The report is well illustrated with graphs, charts, maps, etc. and should prove useful to any city interested in undertaking a similar survey. The survey was taken by Wilbur Smith and Associates, New Haven, Connecticut. (Winnipeg, Metropolitan Planning Commission of Greater Winnipeg, 1958. 319p., $3.00. Summary report free)

A TREATISE ON THE INTERNAL MECHANICS OF BALL, TUBE AND ROD MILLS

One of a series of monographs on powder metallurgy the object of this volume is to bring together information on the internal mechanics of the ball, tube and rod mills, to analyze it in the light of the authors' experience, and to present the results as far as possible in a systematic form.

Although there is literature available on the general design and operation of a tumbling mill, this is the first volume to be devoted solely to the internal processes, and it covers such topics as the motion of the mill charge; power required to drive a mill; the comminution of solid bodies; the actual grinding process in the mill; surging and vibration; metal wear in mills, and the role of additives.

Dr. Rose is well known for his earlier books on electrostatic precipitation and

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the measurement of particle size in fine powders. (H. E. Rose and R. M. E. Sullivan. Toronto, Longmans Green, 1958. 258p., $5.00.)

VACUUM TUBE RECTIFIERS

Vacuum tube rectifiers play an important part in much electronic equipment where an a-c current supply often has to be converted to d-c.

This book covers the fundamentals of vacuum tube rectifier theory, and discusses the physical characteristics of rectifiers, single and polyphase rectifiers, output filter circuits and rectifier and filter design data. Theory and circuitry are given for half-wave and full-wave rectifiers, voltage-multiplying circuits, polyphase rectification and filter circuits. (Alexander Schure. New York, Rider, 1958. 69 p., $1.50.)

°VIBRATION AND IMPACT

An introductory treatment of vibrations and of oscillatory phenomena in general that bridges the gap between introductory dynamics and advanced field of engineering analysis. Free vibration, damping, impact, steady forced as well as nonlinear vibration, systems with two degrees of freedom, waves, vibrating beams, and fatigue are discussed. Problems are directed toward the application of theory to practical situations. (R. Burton. Reading, Addison-Wesley, 1958. 310 p., $8.50.)

°VIBRATION CONTROL

Presents a broad coverage of the subject ranging from elementary vibration theory to specific areas such as rotor balancing, vibration isolation, steady state and transit response, and sound control problems. Diverse means of analysis are studied including the impedence method for steady state vibration, the operational calculus and electronic analogue computer for transient analysis, methods for analyzing non-linear systems, and possible uses of the electronic analog simulator. (John N. Macduff and John R. Curreri. Toronto, McGraw-Hill, 1958. 465p., $10.80.)

THE WORLD ALMANAC, 1958

The latest edition of this mine of information contains a chronology of the events of 1957, together with a list of the major events of that memorable year which saw the launching of the first earth satellite.

The editors are careful to state "The World Almanac does not decide wagers", but many arguments have been settled by consulting its pages. Much of the information given concerns the United States: government, population, education, states, associations, etc.

Other topics taken at random from the index include: alcohol, boiling point; Buddha; Cinerama; diesel engine; engineering associations. From A. A. V. champions to Zuider Zee, you name it, and The World Almanac probably has it. The Almanac deserves a place in every office and home. (Ed. by Harry Hansen. New York, World-Telegram, 1958. 896p., $1.50 pa.)

Sixth Commonwealth Mining and Metallurgical Congress, 1957

The Sixth Congress met in Canada in 1957, and for this event several volumes were produced on Canadian mining and related topics. Between them they cover the geology of Canadian ores and minerals and their mining and milling, and provide a survey of the subject which has long been needed.

Further details on each volume are given below. The volumes are all published by the authority of the General Committee of the Sixth Commonwealth Mining and Metallurgical Congress.

THE GEOLOGY OF CANADIAN INDUSTRIAL MINERAL DEPOSITS

The deposits described in this volume are, with few exceptions, those which are operated at present. Rock quarries are not described, but the geology of major rock formations and clay deposits is given. The papers have been contributed by various operating companies, and geologists from universities and Federal and Provincial governments.

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• HYPALON Oxidizing chemicols Pickling solutions Bleoch solution Freon 12	— 40°	+ 200°
• SILICONE Dilute ocids Alcohols Dilute Alkoli	— 100°	+ 500°

	Recommended Service Temp. Fah. Min.	Max.
• NATURAL RUBBER Air, Water Most diluted ocids Hot Air, water	— 50°	+ 180°
• VICTAULITE Oil Gosoline Most Petroleum Generol Service	— 15°	+ 180°
• LOW TEMPERATURE As above Where cold climates prevoil	— 50°	+ 180°
• NEOPRENE Hot Oils Sour crude Hot compressed oir	+ 30°	+ 200°

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The minerals described range from Actinolite to Witherite, including more detailed coverage of asbestos, clay, gypsum, limestone, magnesite, mica, salt, sandstone and quartz, and talc and soapstone.

Information given on the various minerals includes location and size of deposits, annual production, working methods, etc., and references to further information are given for most minerals. (Ed. by M.F. Goudge. Canadian Institute of Mining and Metallurgy, Industrial Minerals Div. 247p., maps. $10.00.)

THE MILLING OF CANADIAN ORES

The aim of this volume is to present an outline of techniques used in Canadian mineral dressing plants. The material has been contributed by the different mining companies, and the government departments concerned.

The first four chapters form a general introduction, and cover the history of milling in Canada, mineral dressing and testing facilities, a general description of milling areas in Western, Central and Eastern Canada, and outline Canadian milling developments. There is also a list of mills operating or under construction at the beginning of 1957.

The remaining chapters cover the milling of the different ores etc. mined in Canada; gold, silver-cobalt, copper, lead-zinc, uranium, asbestos, coal, iron, and the less common minerals including molybdenite, tungsten, titanium, and mercury. Information is given on the different mines engaged in the production of the different ores, including type of ore, mill capacity, mill production, method of operation, etc.

The volume also includes a bibliography listing over 400 items on Canadian milling practice, and a special printing of the Department of Mines and Technical Surveys map of the principal mineral areas of Canada. (Ed. by John Convey, 447p., $10.00.)

MINING IN CANADA

This volume on Canadian mining practice has been produced in co-operation with the various mining companies and other individuals interested in the subject.

The topics covered are: shaft sinking; drifting and raising; mining methods including the following, open pit, trackless, caving, blasthole, shrinkage, cut-and-fill, square-set stopping, benching, stope filling and dredging; drilling practice; explosives; ground support; rockburst control; mine ventilation and fire control; hoisting; underground haulage; underground crushing, conveying and ore storage; drainage and pumping; mine safety; coal mining. The majority of the subjects are covered by papers referring to the practice at specific mines.

The tables included are compiled from questionnaires sent to all major producing metal mines in Canada, and give data on: mining methods, shaft sinking practice, drifting, raising, drilling, underground haulage, stope filling and hoisting. Many bibliographic references and illustrations are included. (Ed. by J. C. Parlee. Canadian Institute of Mining and Metallurgy, Metal Mining and Coal Divisions. 597p., $10.00.)

STRUCTURAL GEOLOGY OF CANADIAN ORE DEPOSITS, VOL. 2

The first volume of this set was published in 1948 to mark the 50th anniversary of the Canadian Institute of Mining and Metallurgy. The purpose of this volume is to cover the mines and districts discovered or developed since 1948, to describe those omitted in the earlier volume, and to revise the information where the geological picture has changed since the earlier volume was published.

The papers are again divided according to the main geological regions; Cordillera; Western Plains; Precambrian Shield, Western, Ontario and Quebec; Appalachian.

The book is well illustrated with photographs, diagrams and maps, and there are the usual references for further reading. It should prove a useful companion volume to the earlier one. (Ed. by Geoffrey Gilbert. Canadian Institute of Mining and Metallurgy. 524p., $10.00.)

(Continued from page 91)

Canada's Graduate Student Problem

Canada has a serious graduate student problem in science and engineering, in the opinion of R. R. McLaughlin, dean of the Faculty of Applied Science and Engineering, and professor of chemical engineering at the University of Toronto. He dealt with this subject in a speech to the Toronto section of the Chemical Institute of Canada in January.

Dean McLaughlin posed three questions about graduate students: (a) are there enough of them? (b) are they the best procurable? (c) are they working under the most desirable conditions? He answered these questions in the negative.

The question of quantity concerns the universities, and it also concerns the well being of the country. Although addition to the sum-total of human knowledge, essential to a university, could be taken care of by the staff, if necessary, there must at least be a body of graduate students sufficient to maintain the supply of professors at its present level. But, said Dean McLaughlin, universities are made great rather by the mutual stimulus provided by an active staff and an active body of graduate students. Graduate schools must be encouraged, especially in the engineering schools, where the general level of activity is much too low.

The second part of the question is more complex: "Are there enough graduate students so far as Canada is concerned?" If "the second half of the twentieth century belongs to Canada", we must help to make it so. The brains, ingenuity, and will, do exist but a suitable environment for their development is not present either qualitatively or quantitatively. A leaven of research and higher learning beyond the bachelor's degree is necessary if Canada is to be equal to her destiny. "We must develop our own scientific and engineering frontiers and take our place in the world of science, and not just export our brains to make their contributions elsewhere", Dean McLaughlin said.

On graduation with a B.A.Sc. degree, an engineer faces the choice of a salary of at least $4,500 in industry or the prospect of graduate work on a fellowship of $1,500 or less. Should he proceed to the Ph.D. degree there is the prospect of a long financial battle. It is hard to prove that it is financially as profitable over a lifetime to achieve a Ph.D. as it is to have a bachelor's degree—in view of salaries in industry.

While the universities are very grateful to the donors of graduate fellowships, it must be said that there aren't nearly enough and they aren't nearly big enough.

The practice is a wise one, by which worthwhile fellowships are usually not, because of their scarcity, awarded to students proceeding only to a master's degree, because it is only after a year of graduate work that a student can be proved to be of Ph.D. calibre. It is a foolish practice too, because it prevents many first class students from making a start.

Remedies are simple, Dean McLaughlin said. They are: an adequate number of graduate fellowships worth $3000 per annum, beginning at the master's level; allocation to the universities of an adequate sum of money to be dispensed to best advantage without specifications of neatly documented sums into which it must be subdivided. In contrast, the situation is "chaos and inefficiency personified", in Dean McLaughlin's opinion. To the professor who wants to carry out research and to encourage potentially good graduate students the inability to make early, firm offers is a very serious impediment. Without the monumental efforts of the National Research Council in fostering research, a very sorry situation would exist today. "But" he asked, "have we not reached the point where it should be recognized that supporting graduate students represents normal expense in running a university and that funds should be granted directly to the universities for administration in the normal way?"

Considering whether these graduate students would find satisfactory employment in Canada, Dean McLaughlin said that if graduate schools in engineering and science are not developed, the nation will fall behind in this scientific age. But if adequate positions for such graduate students, are not available, then we cannot keep the graduate schools at the proper level, or if we do, we will simply export some of our best brains. There are reasons why Canadian Ph.D.'s go to the U.S. for work commensurate with their abilities. For one, Canadian industry has in general given only lip service to research. Research requires "patient money", not vast quantities, and faith: and the results may be surprising. Another reason is that foreign companies with subsidiaries in Canada tend to reserve all research activity to their own country. A proportionate amount of the research now carried on outside Canada by parent companies would, if carried out in Canada, be productive and is essential to our economic growth, said Dean McLaughlin.

Did You Know That . . .

On a population basis the Engineering Institute is larger than any United States or British engineering society.

Nuclear Congress, 1959

Canadians Invited to Present Papers in Nuclear Field

The Fifth Nuclear Congress is scheduled for April 5-10, 1959 in Cleveland, Ohio.

The Engineering Institute of Canada, as a participating society, will provide for the Nuclear Engineering and Science Conference one or more technical papers. Authors are invited to submit summaries (300-500 words) of proposed papers. Summaries should be received at Headquarters by October 1, for transmission to the Congress Manager.

Authors will be notified in October of the selection of papers for the program, and will be given specifications for the preparation of manuscripts, to be received by the E.I.C. by November 28.

Interested authors should send summaries to: Dr. Garnet T. Page, The Engineering Institute of Canada, 2050 Mansfield St., Montreal 2, Que.


CRANE

MONTH TO MONTH

Athlone Fellowship Winners, 1958

Thirty-eight young Canadian engineers have been chosen to go to Britain this year for two years' further study under the Athlone Fellowship scheme.

The scholars will go to universities in Britain, technical colleges and many branches of British industry. Some will be trained both in university and in industry. No pains will be spared to ensure that they get the training that they want, and that they may return to Canada to resume their careers with improved qualifications and a knowledge that will be valuable both to Britain and Canada.

The Athlone Fellowships scheme is managed in the United Kingdom by a committee representative of industry, the universities and the United Kingdom Government. This committee exercises a general supervision over the administration of the awards and the arrangements for the reception and placing of the Fellows, and also concerns itself with their welfare and progress.

Hitherto the chairman of this committee has been Sir Arthur Fleming. He has recently resigned and has been succeeded by Sir Claude Gibb.

These are the 1958 Athlone Fellows:

1958 Graduates

University of British Columbia: J. H. Duerksen, s.e.i.c., chemical; A. G. Fowler, s.e.i.c., electrical; T. A. Nordstrom, electrical; R. S. Roger, s.e.i.c., electrical.

University of Alberta: D. A. Markle electrical; W. S. Pawluk, chemical; J. A. Sovka, chemical.

University of Manitoba: C. J. Brown, s.e.i.c., mechanical; A. Wexler, electrical.

University of Saskatchewan: C. E. Till, electrical.

University of Toronto: J. B. Ellis, electrical; J. D. Hardwick, engineering and business; A. E. P. Matthews, engineering and business; K. J. Merklinger, electrical; N. M. Seagram, s.e.i.c., engineering and business.

Ecole Polytechnique: M. Phaneuf, s.e.i.c., mechanical electrical; P. E. Tremblay, s.e.i.c., electrical mechanical.

McGill University: S. R. Borenstein, s.e.i.c., engineering physics; I. A. Soutar, mining; W. S. Wilson, metallurgy.

Laval University: L. Lachance, civil; C. Roy, s.e.i.c., metallurgy.

University of New Brunswick: D. M. Caughey, s.e.i.c., electrical.

Nova Scotia Technical College: G. L. Basso, s.e.i.c., mechanical; W. G. Roberts, s.e.i.c., mechanical.

Queen's University: F. C. Lockwood, s.e.i.c., mechanical; S. D. Robertson, s.e.i.c., electrical; H. R. Whiteley, s.e.i.c., civil.

Engineers from Industry

Queen's University: A. L. Barry, electrical; D. R. I. Low, chemical.

University of Toronto: B. G. Bodroghy, mechanical; B. G. Loncarevic, geophysics.

University of British Columbia: D. P. MacKinnon, mechanical.

University of Saskatchewan: R. F. Critchley, jr.e.i.c., mechanical

Nova Scotia Technical College: J. D. Brown, s.e.i.c., civil; W. A. Clarke, jr.e.i.c., mining.

Laval University: J. Y. Savard, electrical.

University of New Brunswick: E. M. Fanjoy, s.e.i.c., electrical.

THIRTY-FIVE YEARS AGO

Comment on the Journal of June 1923

H. D. Savage of Combustion Engineering Corporation, was the author of a paper in the June 1923 issue outlining the advantages to be gained from pulverizing Canadian fuels. While the costs quoted are out of date due to economic changes, the author reached the conclusion that all the coal native to Canada could be successfully used in pulverized form.

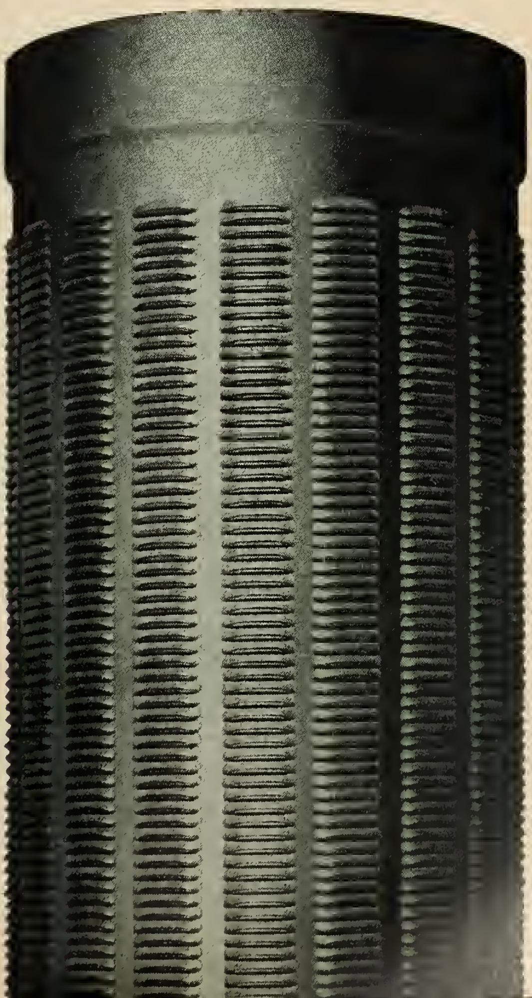
Editorially, reference was made to the National Conference on Education and Citizenship held in Toronto in April. The various engineering acts in effect in the various provinces were compared, giving for seven of the eight major provinces in which there were Associations of Professional Engineers, regulations as to admission, division of engineering as to branches, transfer fees, licenses and license fees, annual fees, minimum age for registration, penalties, examinations and restriction of activities of Associations.

A report was given on the spring meeting of the American Society of Mechanical Engineers, held in Montreal. Canadian arrangements had been under the direction of H. H. Vaughan, M.E.I.C., vice-president of the ASME. ASME president, John Lyle Harrington of Kansas City, in his presidential address, expressed his belief that it was the engineer's duty to take a more active part in politics. ASME secretary, Calvin W. Rice, who represented the Engineering Institute of Canada at the Great World Conference in South America in 1922, gave an account and travelogue of that meeting.

The Saint John Branch held their annual meeting on May 8, at which A. G. Tapley, A.M.E.I.C., the retiring chairman discussed economics of the Maritime Provinces, and in particular their fuel resources. In concluding, he remarked that "while provincial associations were purely business organizations, the Institute was our place of accounting for that which we are doing, for the exchange of ideas, etc., —our forum or campfire, if you like".

At the Ottawa branch, members had listened to President A. J. Nesbitt, of Nesbitt Thompson and Company as he described then current developments of hydro power in Canada, stating that only some 7 per cent or 3 million horsepower out of a potential of between 18 and 41 million hp. had yet been developed, most of it in Quebec and Ontario, used largely for the pulp and paper industry. The cost per developed housepower varied between $60 and 150. He predicted Canada would have 6 million hp. developed within the next decade.

Letters from members were published, dealing with the recent opening of the international bridge at Edmunston and with the compressive strength of cement. A third letter dealt with Canada's Fuel Problem by H. E. M. Kensit, M.E.I.C., in which it was pointed out that some 60 per cent of Canadian coal consumption was imported. Per capita coal consumption had decreased from 4.2 lb. in 1913 to 3.5 lb. in 1921. This he said, was due to the increasing use of water power. Use of coal in per cent of total consumption was divided as follows: steam railways, 29 per cent; bunker coal, 4 per cent; industries and coke, 34 per cent; electric light and power, 2 per cent; and domestic uses and gas, 31 per cent. *H.G.C.*



Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

New Officers—A. S. Austin has recently been elected president of The Austin Company Limited, Toronto, succeeding G. A. Bryant; G. Galloway has been appointed vice-president.

Canadian Bitumuls Company — E. M. Lorenzini, manager of Bitusize sales for the American Bitumuls & Asphalt Company, has been elected president of Canadian Bitumuls Company Ltd., a subsidiary of the American company. Mr. Lorenzini replaces retiring president, W. Summers.

Executive Appointment — Announcement has been made of the appointment of T. N. Beaupre as president of Columbia Cellulose Company, Limited and Celgar Limited, B.C.

C.G.E. Director — J. A. Béland, of Louiseville, Que., has been elected to the board of directors of Canadian General Electric Company Limited.

Bathurst Containers—E. H. Gibson has been appointed director of sales, Bathurst Containers with headquarters in Montreal. Mr. Gibson replaces H. S. Litteljohn, who resumes his former position as consultant to the president of Bathurst Power & Paper Company Limited, and will be located in Hamilton, Ontario.

Catalytic Construction — Recently announced by the Catalytic Construction Company of Canada Limited was the appointment of I. M. M. Buchanan as manager of the company's new Western office in Vancouver, B.C.

RCA Victor Company — J. D. Houlding vice-president, technical products, RCA Victor Company, Ltd., has been elected a director of the company.

Trans-Canada Pipe Lines—S. R. Sawyer, formerly of El Paso Natural Gas Company, has been named chief engineer of Trans-Canada Pipe Lines Limited, with headquarters in Toronto.

Technical Service Laboratories — The appointment of E. W. Warren as sales development consultant has been announced by Technical Service Laboratories, Toronto.

E. H. Gibson

H. S. Litteljohn

I. M. M. Buchanan

Inco Appointment — F. F. Wood has been named assistant to the vice-president (publicity and advertising) of The International Nickel Company of Canada Limited, and assistant vice-president (publicity and advertising) of the company's United States subsidiary, The International Nickel Company, Inc.

Stelco Appointment — The Steel Company of Canada Limited has announced the appointment of A. R. McMurrich as general manager, field sales, with headquarters in Hamilton, Ont. Mr. McMurrich will direct the company's branch sales offices and outside sales personnel from coast to coast.

C-I-L Appointments — W. A. Taylor has been made sales manager of the chemicals division of Canadian Industries Limited. He succeeds H. G. Campbell, who has been assigned special duties in the office of the division's general manager.

Canadian Resins and Chemicals — The following changes have recently become effective at Canadian Resins and Chemicals Limited: R. E. Hughes is appointed manager of development; A. G. Pinard becomes manager, industrial products

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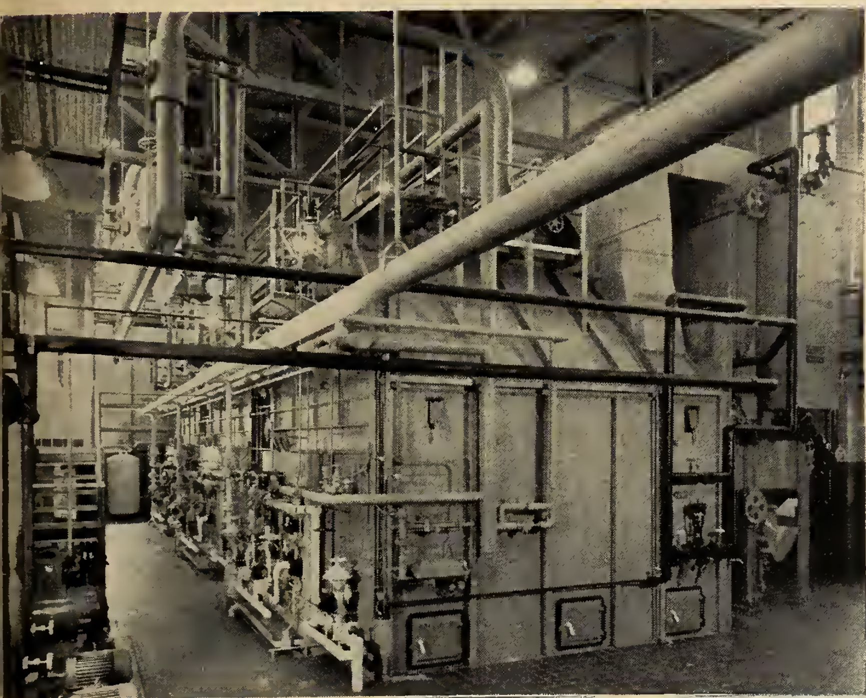
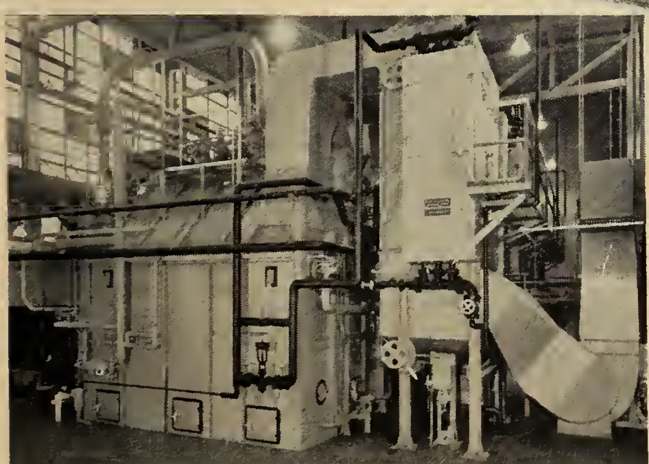


The new Vancouver Shaughnessy Hospital of the Department of Veteran's Affairs is a modern and efficient institution.

Its construction is a tribute to the Department of Public Works of Canada and their architects and consultants.

Foster Wheeler is proud to add these three S A Boilers to the almost six hundred other units of this type in service across Canada.



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HALIFAX • MONTREAL • TORONTO • ST. CATHARINES • WINNIPEG • EDMONTON • VANCOUVER department; and E. A. Clout, supervisor, calendered materials division.

Dominion Engineering — Recent announcement was made of the promotion of W. L. Brown to the position of manager of purchases, Dominion Engineering Works Limited, following the retirement of A. A. Levick.

E. A. Burgess becomes advertising coordinator within the department; and D. G. Blackmore has been made supervisor of publications.

Sales Appointment—Philips Electronics Industries Ltd., of Toronto, announce the appointment of H. L. Pollock as sales engineer in the aviation and electronic components group.

Matthews Conveyer — J. S. Laurie has been appointed assistant manager and director of purchasing of Matthews Conveyer Company Limited and W. S. Raynor, M.E.I.C., becomes chief engineer.

News of Business and Industry

General Motors Appointment — H. F. Shepherd, formerly locomotive parts manager, has been named parts manager of General Motors Diesel Limited, London, Ont.

MAAG Appointment — Announcement has been made of the appointment of J. P. Kummer as manager of the newly established Lathem Time Recorder Division of MAAG and Company Limited.

Anthes-Imperial Company — S. R. Spence has been appointed general sales manager, Western division of the Anthes-Imperial Company Limited; and will be located in Winnipeg.

Emco Advertising Appointments — Reorganization of their advertising and publications department has been announced by Emco Limited of London, Ont.: J. M. Hunter has been appointed manager, advertising and publications;

Canadian Representatives — A new line of products is being introduced to the Canadian market by A. C Wickman Limited, Toronto. The company has been appointed representatives of Daytronic Corporation, Dayton, Ohio. Principal items distributed will be motion transducers, force transducers, controllers, transducer amplifiers; these are especially applicable to users of instrumentation, manufacturers and users of process control equipment, automatic inspection systems and automatic weighing systems.

Relocation of "3M" Sales Office — The relocation of their Toronto branch sales office has been announced by Minnesota Mining and Manufacturing of Canada Limited. The new address of the "3M" Toronto branch sales office is Keele and Lawrence Plaza, P. O. Box 1201, Postal Station "T", Toronto 19, Ontario. The telephone numbers are CHerry 4-5607 and ROger 6-6166 for suburban customers. The sales office for Thermo-Fax Copying Products will remain at its present location, 227 Eglinton Avenue West.

Dominion and Regional Safety Honours —Top Dominion and regional honours for outstanding achievement in the prevention of accidents have been awarded to The Consolidated Mining and Smelting Company's Bluebell Mine at Riondel, B.C., for 1957. It is the first time that the John T. Ryan Dominion Safety Trophy for metalliferous mines has been won west of Ontario.

Computer Program — Adalia Computations Limited with their technical personnel and the facilities of their Datatron 205 computing system have evolved a mathematical program which they state will help industrial and commercial concerns to improve their operations in a large measure. This program yields an economic forecast over a period up to 19 years and is said to be capable of handling monthly and seasonal adjustments and various statistical calculations. The electronic computer has been programmed in a very general manner so as to be adaptable to the needs of most clients: banks, insurance companies, investment dealers, wholesale distributors, department stores, consumer goods manufacturers or any other commercial or industrial ventures.

Foundation Company Contract — The WoodGreen master plan of development and expansion has entered its second stage with the signing of a contract for The Foundation Company of Canada Limited to construct the second group of buildings in the plan. The WoodGreen Foundation, non-denominational in nature, was incorporated by Ontario charter for charitable and social welfare purposes in the east Toronto WoodGreen area. Building of the WoodGreen Community Centre by the Foundation Company in 1947 was the first stage in the master plan. The second stage involves the construction of a new church, from funds already raised for that purpose, and of an adjoining non-sectarian building to be known as WoodGreen Neighbourhood House.

Company Acquisition — The Timken Silent Automatic Division of Scaife Company, Toronto, has been acquired recently by Iron Fireman Manufacturing Co., Toronto. The Timken Silent Automatic Division manufactures and distributes residential heating equipment, including oil and gas-fired burners, furnaces and boilers.

Canadian Distributor — Arrangements have been completed to link Kearfott Co. Inc., of Little Falls, New Jersey, designers and manufacturers of technical components and systems in the U.S., with Canadian Applied Research Limited. Applied Research will act as exclusive Canadian distributor for Kearfott products.

Latex Handling Plant — The opening of a new Latex handling plant was announced recently by the Polymer Corporation Limited. The latest addition in the company's expansion program is situated at the north end of Polymer's property near No. 40 Highway. Of steel, red brick, and transite, the unit was designed and constructed at a cost of 1.9 million dollars. Built to a height of three stories to take advantage of gravity flow its design is said to include novel and unique features. Notable among these are resin-lined tanks and glass piping throughout the latex handling systems to reduce fouling and plugging of lines.

New Affiliate — The formation of a new affiliate has been announced in Montreal by Canadian Liquid Air Company Limited. The new company, to be known as International Underwater Contractors Limited, will specialize in a wide range of underwater operations previously impractical because of the limitations imposed on a diver using conventional diving equipment. International Underwater Contractors claims to be unique as an organization of personnel specially trained to work with tools and equipment under water, and in locations and under conditions said to be impossible for the old-fashioned diver with his cumbersome suit and many other restrictions on his movements and diving time.

Polyethylene Plant Expansion — Another expansion in production capacity for polyethylene resins was announced recently by the Carbide Chemicals Company, division of Union Carbide Canada Limited. Work is now underway on a multi-million dollar addition to the company's Montreal East plant to increase polyethylene capacity by 12,000,000 lbs. per year. Scheduled for completion in April 1959, the project will increase the plant's total production of polyethylene resins by approximately 30% per year.

New 2-Way Radio Base Station — A new base station with remote control console has been designed and manufactured by Canadian Westinghouse Company Limited. Designated the WPM-10 series, these two units incorporate operating features not found in comparable equipment, the company claims.

A major problem of VHF transmission is the signal loss caused by geographical obstacles. To overcome this difficulty, the base station and antenna are mounted on the highest object in the vicinity; the base station is then operated by a remote console from a local office. Emergency standby power is provided by battery packs built into the control console and the base station.

Royal York Hotel Extension — About 3,500 tons of steel was fabricated and erected by Dominion Bridge Company Limited for 17 storey extension to the Royal York Hotel, Toronto. This company also erected the steel for the original Royal York Hotel in 1928. When the extension to the hotel is completed in December 1958, the British Commonwealth's largest hotel will have increased its number of guest rooms to 1,600 and approximately doubled its convention space. The tool being used to tighten the last bolt is an Ingersoll-Rand model 5340T torque control impactool for precision fastening of heavy bolted steel structures. It has an adjustable torque range up to 550 foot pounds.

Electronics Service Expansion—Expansion of the electronics division of A. C. Wickman Limited, Toronto, has been announced by the company; it is marketing, in Canada, products of Dynamic Instrument Company, of Cambridge, Mass., which include a complete range of strain gauge pressure transducers, flow meters and force transducers.

New Equipment and Developments

Mine Hoist Equipment — The electrical drive and controls for the skip and cage hoists at The International Nickel Company's Thompson mine, in northern Manitoba, have been ordered from the Canadian Westinghouse Company. Approximate value of the installations will be $500,000. This will be the first application of static controls to mine hoist equipment in North America. Westinghouse Cypak with Magamp controls and advance selector device will provide operation on the same principle as pushbutton control for automatic elevators. The application was made possible by a Canadian Westinghouse invention which allows the operator to select the level and activate the hoist with a permanent magnet.

The Thompson Mine is one of two nickel mines being opened up by Inco in a $175-million development in the Thompson-Moak Lake area some 400 miles north of Winnipeg.

Radiographic Unit—Dominion Foundries and Steel Limited announce that their new Cobalt camera has a power rating of 755 curies and that it is one hundred times as powerful as the unit which it replaces. The camera employs radioactive Cobalt 60 as its source of power and is used for the radiographic inspection of steel castings in Dofasco's foundry. Its high power source enable the machine to probe through solid steel in its search for hidden flaws. The device is located in a 3-foot-thick concrete walled pit, 14 feet below ground level. Operation of the unit is by remote control. In the event of either electrical or mechanical power failure during an exposure, the mechanism will automatically render itself harmless, by restoring the radioactive source to its radiation-proof compartment. There is no absorption of radioactivity by the steel during radiography and the object being tested is absolutely safe immediately the exposure is over.

The personnel who operate this unit have had considerable training and experience and all precautionary measures are taken to assure that no danger exists.

Semi-Automatic Welding Machine — Air Reduction Canada Limited has announced the new model 2700 magna-welder for semi-automatic welding of mild steel and for hardfacing applications. It is designed for use with fabricated, tubular wires for hardfacing, and is adaptable for submerged arc welding. The model 2700 with a ⅜ h.p. universal drive motor operates from any 400 ampere AC or DC welder. The only electrical connections required are to clip the electrode cable to the magna-welder and the ground cable to the work piece. The geared feed rolls permit the use of both solid and tubular wires. There is an "inch switch" that permits both short wire advance and wire retract. The motor has a dynamic brake to prevent wire overfeed when the arc is broken.

555 mw Turbo-Generator Set—The Central Electricity Generating Board have placed an order for a 550 mw turbo-generator, condensing and feed heating plant with C. A. Parsons & Co. Ltd. of Newcastle Upon Tyne, England. The machine is said to be the largest in the world to be ordered and is for the projected Thorpe Marsh Power Station in Yorkshire, England.

The turbine will operate with steam at a pressure of 2,300 lb./sq. in at the stop valve and a temperature of 1050° F. with reheating to 1050° F., the steam being supplied to the machine through two steam chests arranged on each side of the high pressure cylinder. The unit consists of two lines arranged in the line ahead, each line comprising four cylinders driving a 275 mw three phase generator.

Galvanized Steel Sheets — A Canadian metal fabricating firm has announced that they have found a new, functional, and decorative application for a U.S. Steel galvanized steel sheet product. Customarily used for tightly sheathed building roofs and sidewalls, U.S. Steel's 5V-crimp galvanized steel sheets have been adopted as a garage door material by Ladore & Company, Ltd., of Walkerville, Ontario. It is said to be the first

known garage door application for this type of sheet. The company claim that the finished door made of galvanized steel sheet costs less and resists denting.

Automatic Scanning Correlator — An automatic electronic device described by Canadian and U.S. Government experts as "a major break-through in the science of aerial mapping" has been produced by The Photographic Survey Corporation, of Toronto. The device speeds up the process of obtaining information from photographs formerly done by humans up to 100-fold. Overlapping aerial photographs of ground objects is said to reveal "3-D" detail when interpreted stereoscopically by trained operators who transfer the detail to maps or charts by the help of plotting instruments. The new device is known as Auscor (automatic scanning correlator).

Wire Stripper — A new design wire stripper, no. 299, has been announced by Proto Tools of Canada, Ltd. For the professional user, this improved tool which is only 5 in. long features a thumb-operated gauge and is said to strip all commonly used insulated wire from 14 to 24 gauge without nicking or cutting; the larger sizes of wire can also be handled with ease. An advantage of this tool is that it is claimed that all settings can be made quickly; the method is simply to turn the star gauge to the desired notch opening size, notch, and strip.

Wire Strand for Pre-Stressed Concrete — British Ropes Canadian Factory Limited has begun producing stress-relieved wire strand at the Grandview highway plant. Stress-relieved strand is one of the key elements in pre-stressed concrete, and is what provides longitudinal strength in concrete members through certain metallurgical properties that allow for controlled elongation of the strand. This results in complete reinforcing with only a fraction of the metal required under other methods, and marks the essential difference between pre-stressed and ordinary concrete.

Die Lube Stick—A new product, called Die Lube Stick, has been introduced by Lubricants, Inc., Detroit, Michigan. The purpose of the Die Lube Stick is to fill in the scratches or scoring left on the surface of the dies after grinding to remove metal pick-up or galling. It has been found that metal pick-up will not likely occur again in the same area.

Being in a convenient, dry form, much like a large crayon, it can be quickly applied to the area affected and dies need not be removed. Down time is said to be avoided and considerable saving in time and labor effected.

High Vacuum Pumps—The difficulty of deterioration caused by heavy wear, the Pulsometer Engineering Company Ltd. of Reading, England now fit air injection scavenging to their high vacuum pumps which are so arranged that the scavenging air enters the cylinder after the rotor blade has isolated the suction port. The air is then able to support a considerable amount of the water vapour without condensation occurring, particularly when the mixture is raised in temperature as a result of the pump's discharge action. As an example, a discharge temperature of 195° F. would mean that each cubic foot of injected air carries .0265 lbs. of water with it.

Hydraulic Motor Pumps — Tal Bending Equipment, Inc., Milwaukee, Wisconsin, announce the development of a small, portable hydraulic motor pump developing up to 10,000 p.s.i. pressure and weighing 65 pounds. The pump can be used with Tal Hydraulic Pipe Benders, or any other make of hydraulic benders, pipe pushers, knock-out punches, hydraulic jacks of any kind, and can be installed and adapted to give fast continuous power to existing equipment.

The pump is rated for 10,000 p.s.i. intermittent and 5,000 p.s.i. continued duty delivering 80 cubic inches of oil per minute and is driven by a standard ½ HP single phase, 60 cycle, 1,750 R.P.M. 110-220 volt motor.

Portable Compressors — A new range of 100% air cooled diesel-powered portable compressors has been introduced by Atlas Copco of Canada Ltd. on the Canadian market for the first time. Powered by economical Deutz diesel engines, the complete air cooled units are said to offer many advantages from a practical standpoint including large valve areas and high volumetric efficiency to assure long service life and low maintenance costs.

Pressure Filters — The Bird-Archer Company now design and supply pressure filters over a complete range of capacities. Sand and gravel types as well as anthrafilt units are available, and the filters are guaranteed to provide completely dependable filtering, plus clarified water that needs no repumping. Piping and fittings, together with either a nest of individual gate valves or a multiport valve, are supplied to control the operations.

Automatic Emergency Lighting Unit — A new emergency lighting unit, which operates automatically and instantaneously upon failure of normal power and automatically prepares itself for the next blackout, has been developed by Exide Industrial Division of The Electric Storage Battery Company (Canada) Limited. Immediately following an emergency discharge, the model A Exide lightguard automatically recharges its storage battery at a high rate. At the end of the high-rate charge the lightguard automatically returns the battery to a trickle-rate to maintain itself in a state of constant readiness. A temperature-compensated voltage-sensing relay eliminates the need for manual operation.

Dynel Filter Fabrics — Reduced material and labour costs through the use of Dynel filter fabrics in the refining of uranium ore is reported at Blind River, Ont., by a number of mining and milling firms according to Carbide Chemicals Company, division of Union Carbide Canada Limited. Refining mills connected with mines in the Blind River and Bancroft areas utilize Dynel fabrics in vacuum filtration of sulphuric acid solutions to obtain uranium oxide. Woven of Union Carbide's acrylic fibre Dynel, some of the cloths serve to support a distomaceous earth filtration medium in mammoth eimco disc and drum filter units. Other Dynel fabrics are used in clarifying bags as well as in Dorr-Oliver neutral bags.

New Taylor Recorder — Newest of the Taylor line of recorders is the 90J series four inch strip chart recorder. Designed for use with any of the Taylor line of miniature controllers, this instrument is said to provide more features in less panel space than any recorder regardless of size. For simple recorder applications, one to three pens or indicators may be provided. Use as a receiver for a Taylor controller requires only a simple change to include set point transmitter, automatic to manual switching lever and cascade selector.

Teflon Clipper Seals — New chempac teflon clipper seals, to enable industrial plants to obtain positive sealing in the presence of active solvents and corrosives are now available from Canadian Johns-Manville Co. Limited. The new J-M seals are claimed to have successfully contained oils with varying aniline points that are destructive to many compounds, and also proved effective against such widely diverse fluids as rocket engine fuel, perchlorethylene, destructive insecticides, and various refrigerants.

New A-C Vibrating Feeder — A vibrating mechanical feeder designed to facilitate handling of sticky material from hopper to plant has been developed by Canadian Allis-Chalmers Limited. The first two units—4 by 9-ft. feeders with no. 4 mechanism in operation in Michigan—are handling 150 long tons per hour of run-of-the-mine iron ore containing 2½ percent alumina and having 10 to 16 percent moisture content.

Gyroscopes — According to Sperry Gyroscope Company of Canada, Ltd., Montreal, early achievement of low cost, extremely accurate gyro systems for stabilizing and guiding missiles, aircraft and even sea vessels has been made possible by the development of "frictionless" gyros by its parent company, Sperry Gyroscope Company, Great Neck, New York. The development is said to hinge on a unique method for controlling ball bearings within "simple" gyroscopes; it represents the removal of a technical impasse in the gyro art that has blocked efforts to approach absolute precision since practical gyros were developed near the turn of the century.

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MEET THE AUTHORS

Charles Miller, M.E.I.C., Construction Project Manager, Canadian British Aluminium Company Limited, Baie Comeau, Que. *(Aluminium Reduction Plant at Baie Comeau, Que.; and The Manicouagan Power Development.)* Mr. Miller graduated in engineering from Queen's University, Kingston, Ont. (B.Sc., Civil, 1930). He was chief hydraulic engineer and manager of construction during the building of Stage I of the Manicouagan power development. Mr. Miller was formerly general superintendent of the Beauharnois Light, Heat and Power Comany.

W. G. Street, Chief Plant Construction Engineer, Canadian British Aluminium Company Limited, Baie Comeau, Que. *(Aluminium Reduction Plant at Baie Comeau, Que.)* Mr. Street received his engineering training with W. H. Allen Sons and Co. Ltd., Bedford, England, and was subsequently employed as chief plant engineer, Star Aluminium Co. Ltd., Wolverhampton, and assistant engineer, Courtaulds Ltd., Coventry, England. In 1939 he joined the British Aluminium Co. Ltd. and held position of chief engineer at their Swansea smelter and Latchford recovery works, and chief electrical engineer at the Falkirk rolling mill; he became Senior Plant Engineer in 1947 at their head office, London. He took charge of the engineering team on technical design of Canadian British Aluminium Company Limited, in 1956; Mr. Street is a member of the Institution of Electrical Engineers, U.K., and of the American Institute of Electrical Engineers.

T. A. Hughes, M.E.I.C., Chief Field Engineer, C. D. Howe Company Limited, Montreal. *(Aluminium Smelter Dock at Baie Comeau, Que.)* Mr. Hughes received his engineering qualifications in Wales (B.Sc., civil, University College, 1942). Following service in World War II he gained professional experience in Great Britain prior to coming to Canada in 1953. He acted as co-ordinating engineer for the Canadian British Aluminium project at Baie Comeau, and has been closely associated with it through all stages from the preliminary studies to commissioning of the smelter plant. Mr. Hughes is an Associate Member of the British Institution of Civil Engineers and the Institution of Structural Engineers.

V. M. Wallingford, M.E.I.C., Resident Engineer, Canadian British Aluminium Company Limited, Baie Comeau, Que. *(Aluminium Smelter Dock at Baie Comeau, Que.)* Mr. Wallingford graduated from the University of Toronto in 1944 (B.Sc., civil engineering). He joined the Anglo-Canadian Pulp and Paper Mills, Forestville, Que., in 1945. In 1949 Mr. Wallingford became project engineer with the Ontario Hydro consulting division, Toronto, and he transferred to the Manicouagan power project No. 1, for the Ontario Paper Company as assistant resident engineer the following year. He took on the post of project engineer with the Anglo-Canadian Pulp and Paper Mill Ltd. in 1953. General superintendent, Eastern area, the following year for Mannix Ltd., he assumed duties as resident engineer, New Brunswick Electric Power Commission, Beachwood power project, in 1955.

J. M. Higgins, Manager of Construction, Quebec North Shore Paper Company, Thorold, Ont. *(Manicouagan Power Development.)* Mr. Higgins graduated from the University of Toronto in 1930. He served overseas with the Royal Canadian Engineers in World War II and retired with the rank of major. In 1946 he joined the Ontario Paper Company Limited, central engineering department. Mr. Higgins was promoted to his present position of manager of construction in 1953.

C. M. Stewart, Jr.E.I.C., Senior Engineer, mechanical design section, engineering division, Imperial Oil Limited. *(The Modernization of the Halifax Refinery.)* Mr. Stewart holds an engineering degree from the University of Saskatchewan (B.Sc., mechanical, 1948). After one year's experience with C. A. Energia Electrica de Venezuela he joined Imperial Oil Limited, and has since then been engaged in inspection, mechanical design and construction work. He was associated with the design and specification phase of the Halifax project and followed its construction in the field. He was resident engineer for the powerformer project at Halifax refinery.

COVER PICTURE

The aluminium project at Baie Comeau, Que., described in three papers in this issue, is the subject of the cover picture this month. The picture shows the smelter dock, with conveyor from wharf to silos.

Photo: George Hunter

Aluminium Reduction Plant at Baie Comeau, Que.

C. Miller, M.E.I.C. *Construction Project Manager*

W. G. Street, *Chief Plant Construction Engineer*

Canadian British Aluminium Company Ltd., Baie Comeau, Que.

Read at the 72nd Annual General and Professional Meeting of the Engineering Institute of Canada, Quebec City, Que., May 1958

A new major industry has been established at Baie Comeau, Que., on the North Shore of the St. Lawrence River, with the official opening, on 14th June, 1958, of the Canadian British Aluminium Company smelter. The reduction plant, smelter dock, and associated power developments are described in three papers.

THE FIRST aluminium ingot was cast at the Canadian British Aluminium Company smelter on December 23rd, 1957. This marked the starting of the first stage of production, a bare two years following the initial planning of the project.

The Canadian British Aluminium Company Limited was incorporated under the Province of Quebec Companies' Act on October 26th, 1955, for the purpose of aluminium smelting, with its head office in Montreal. The founder members were The British Aluminium Company Limited, who subscribed sixty per cent of the original stock, and the Quebec North Shore Paper Company, who subscribed forty per cent. Since then a large issue has been made in Canada and the public now own common stock as well as bonds and debentures.

Location

The choice of the site in Baie Comeau, Quebec, was influenced by:

(*a*) The availability of reasonably priced hydro-electric power and the possibility of power being developed quickly and being capable of further expansion as might be required.

(*b*) The availability of good facilities for a deep water harbour for berthing three 10,000 ton ships.

(*c*) The proximity of a modern town in the immediate area with its own harbour and an airport, and served by Highway No. 15 to Quebec City, which would greatly facilitate construction program.

(*d*) The location of the harbour relative to the proposed smelter site within economic road hauling distance and offered facilities for the economic handling of the considerable quantities of the process material to be used.

Project

The initial planning was to build a smelter in four stages, each stage to have a productive capacity of 45,000 tons* of aluminium ingot per annum; each stage to have two pot rooms with a rectifier station at one end and a casting shop at the other, together with the necessary carbon production factory, ancillary buildings, workshops, office, laboratory and raw material stores, etc. The target for these operations was to produce the first metal by the close of 1957, to complete the construction of stage I in the spring of 1958 and to bring stage II into full operation by the middle of 1959. The exact date covering stages III and IV is yet to be decided.

The design and construction of the dock is covered in a separate paper, but in this introduction it should be mentioned that the initial aim was to complete the dock and dock installations during 1957 in time to assist with the unloading of construction material and plant and to deal with the intake and storage of the process raw material required over the winter of 1957-1958.

All targets to date have been achieved with the first ocean going vessel, the M.V. *Luciana* berthing at the C.B.A. dock on May 29th, 1957, bringing material and machinery for the alumina-coke unloading and conveying plant which had been manufactured in Germany, and at the close of the shipping season 1957 a total of fifty-five ships had berthed at the dock, including vessels bringing the alumina and petroleum coke required for the operation of the process over the 1957-1958 winter period.

Preliminary Work

In order to get the job off to an early start the preliminary work was supervised by the Quebec North Shore Paper Company. In 1955 they carried out the clearing of the trees on the site which had been chosen for the plant. They also supervised a contract to a local contractor to start the main access road along the St. Lawrence river to the new wharf site. This work proceeded through the winter of 1955-1956.

Site Preparation and Access Roads

Bids were called in April 1956 and a contract awarded for the excavation and levelling of the industrial site, along with the completion of the main access roads.

The smelter buildings required a

* All weights are given in short tons of 2,000 lb.

space of approximately half a mile square and such areas of level ground are very rare on the rocky north shore of the St. Lawrence river.

In order to carry out the excavation and filling this contractor used over a million dollars worth of heavy construction equipment. The job included the moving of nearly 1,000,000 tons of solid rock and also about 300,000 cu. yd. of common fill.

The major items of construction equipment used by the excavation contractor were as follows: 2½ yard shovel, 1; 1½ yard shovel, 3; D8 tractors, 2; D7 tractors, 2; D6 tractors, 1; front end loaders, 2; road grader, 1; Euclid trucks (15 ton), 12; smaller trucks (sub-contract), 30.

Another job done by this contractor and which involved a very considerable amount of time was the grubbing of the whole area, including removal of the stumps. In a few areas there was a depth of three or four feet of organic material which had to be excavated and hauled out.

Construction Camps

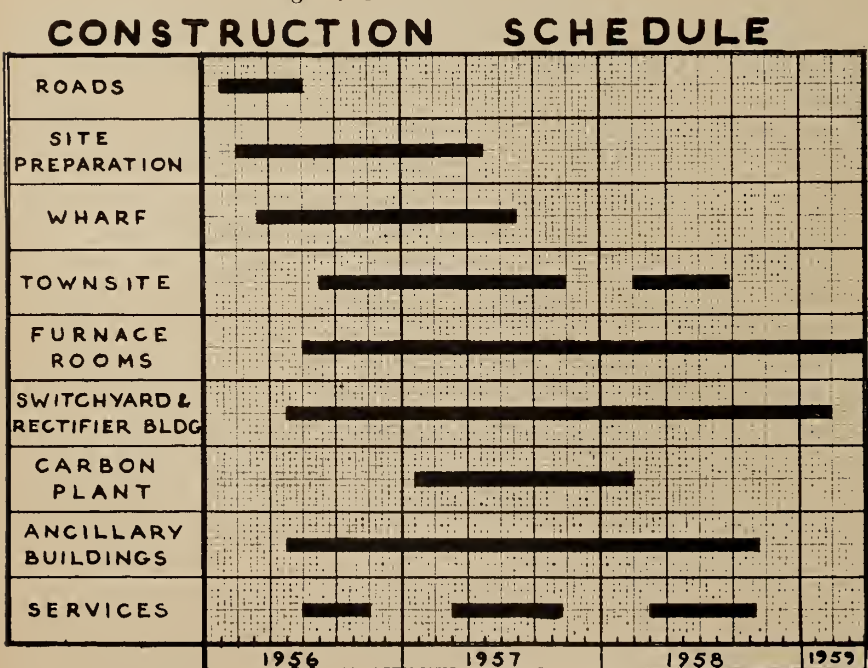
These were provided by the owner who built them in advance of the general contract. The type selected was a demountable two-storey panel camp, which had been successfully used by the Woods Department of the associated paper company. A cafeteria of a 1500-man capacity was built of a steel prefabricated building. Electrical distribution, laundry, commissary, boiler plant, water supply and sewerage system was built. The manpower required for the job was under-estimated, but the camp was expanded to accommodate 3000 men. In addition to construction camps a trailer park was built with complete facilities for 30 families.

General Contracts

The concrete requirements of the job amounted to approximately 120,000 cubic yards for the smelter site and the wharf. In order to efficiently meet the schedule and supply all the requirements it was decided to establish a central ready-mix concrete plant which would supply concrete to all the contractors. The successful bidder erected a ready-mix plant in the record time of four weeks, and delivered the first concrete in June 1956. Their plant was a gravity batcher with one 2 cubic yard concrete mixer. In general, the concrete was premixed in this tilting mixer and dumped into a hopper. To handle the concrete to the job a fleet of 8 ready-mix trucks was used, either as transit mix trucks, each carrying 6 cubic yards, or as agitators with a capacity of 8 cubic yards. In 1957 the single mixer at the batching plant turned out over 90,000 cubic yards of concrete.

The tenders for the construction of the main smelter were called in May 1956. The successful contractor started operations in June 1956 and substantially completed stage I by December 1957. Stage II will be completed in 1958.

Fig. 1. Construction schedule.



This work included the following: office, laboratory, service building, raw material stores, boiler and compressor house, workshops, carbon plant, briquette storage, pitch storage, rectifier building, switchyard, and four furnace rooms, together with casting shop.

The type of construction of the main smelter buildings is a structural steel frame with aluminium cladding. These four furnace rooms are each 1700 feet long and 76 feet wide. They are connected together by corridors at the centre and at each end. Along the west end of the furnace rooms is the rectifier building, and along the east end and connected to the furnace rooms by corridors, is the casting shop.

The ancillary buildings were nearly all built of structural steel frame with patent asbestos-cement insulated sandwich board cladding, and tar and gravel roofs. Only the office and laboratory were built of brick.

The following table shows the major quantities on the civil construction work:

Concrete	120,000	cu. yd.
Backfill	300,00	cu. yd.
Rock excavation	30,000	yards
Structural steel	14,000	tons
Sandwich board cladding	22,000	squares
Tar and gravel roofs	2,250	squares
Aluminium cladding and roofing	6,200	squares
Reinforcing steel	5,650	squares
Piping—steel	25,000	feet
cast iron	25,000	feet
wood stave	12,000	feet
concrete	5,000	feet

Wharf

Tenders for the wharf were called in March 1956. It consisted of building a steel pile wall 3,000 feet long, together with approximately 400,000 cubic yards of rock backfill.

The contractor started operations in April 1956 and completed the wharf in September 1957. Design and construction of the wharf is covered fully in another paper (p. 50).

Construction Materials

The favourable location of Baie Comeau on the trans-Atlantic shipping lanes had an important effect on the source of materials. It is interesting to note that the cost of freight between Montreal and Baie Comeau for less than 500 miles is the same as freight from Europe on a distance of over 3,000 miles. Accordingly, most of the structural steel and cement, some reinforcing steel and much of the equipment came from European countries.

All construction material had to be off-loaded at the wharf as there is no railway connection to Baie Comeau. This unloading was handled by the Quebec North Shore Paper Company's stevedores, and material was hauled to the site by the general contractor.

The total amount hauled amounted to over 120,000 tons.

Townsite

Since the initial two stages of the plant would employ about 900 men, and the complete plant would require about 1500 workers, it was necessary to develop a new townsite. The amount of accommodation for families in nearby towns of Baie Comeau and Hauterive was extremely limited, in fact a serious shortage of houses existed.

A suitable and picturesque site for the new housing development was chosen within a mile of the smelter and wharf. During 1956 municipal improvements were carried out for some 300 lots. During the following year a staff house for 30 guests, three apartment blocks to house 36 families and some 210 houses were built on the new development. In 1957 the townsite was expanded to a total of about 450 lots, and individual housing construction is in progress.

Due to the very rocky nature of the load, it was necessary to haul in to the site all the sand and earth fill, all the gravel for streets and roads and all the topsoil for landscaping. The total amount of this material hauled for the townsite development was 900,000 tons. While this seems to be a tremendous quantity, it was much more economical than the extensive rock blasting which would have been necessary otherwise.

The new townsite, as can be seen from Fig. 6, is very attractive.

Fig. 2 Site preparation. Excavation in progress for smelter site. Beginning of road to townsite at upper left. June 11, 1956.

Plant Installations

A single paper will not allow for anything like a detailed description to be given of the plant. An endeavour has therefore been made to present features that may be of particular interest or peculiar to this particular smelter installation.

Raw Materials Handling and Storage

To provide for the ultimate productive capacity of 180,000 tons of aluminium per annum it will be necessary to bring in something like 90,000 tons of petroleum coke, 360,000 tons of alumina and, in addition, supplies of pitch, fluxing materials, stores, etc. In all, it is necessary that the dock should be capable of handling a total of something like 500,000 tons of incoming raw material per annum with handling and loading facilities required for shipping 180,000 tons of outgoing metal.

A pneumatic unloading plant has been installed at the dock to deal with the handling of incoming alumina and coke which represents the bulk of incoming raw material—two suction towers will be installed under the initial two-stage development.

The towers run on tracks for the full length of one berth. Each tower carries two suction nozzles, each nozzle being capable of handling alumina and coke at a maximum rate of 80 to 90 tons per hour—the material is then passed by cross conveyors in the suction tower to a belt conveyor also running the full length of the berth, which in turn feeds to the main belt conveyor carrying the material to the storage silos which are located to suit the process.

Conveyor

The main belt conveyor system comprises five conveyors, three of which have 42 in. wide belts and two have 36 in. belts. The total length of the conveyors is approximately 3,200 feet and rise 347 feet to the discharge points at the storage silos. The 42 in. belts operate at a speed of 250 feet per minute and the 36 in. at 350 feet per minute. Both alumina and coke are carried by the first two 42 in. conveyors for a distance of approximately 2,400 feet, after which the alumina is carried to storage silos by the third 42 in. conveyor, and the coke to the coke silos by the two 36 in. conveyors, one of which utilizes a tripper for distributing the material to the respective silos. The conveyor drives are interlocked and the system is arranged to cover either the alumina or coke handling operation.

The integrated unloading and conveying system is thus capable of unloading at a maximum rate of approximately 330 tons per hour which can be stepped up to 500 tons per hour by the addition of a third suction unloading unit and by increasing the speed of the conveyor belts from 250/350 to 380/450 per minute. The motors and drive arrangements have been suitably rated to provide for this future development by effecting a change of drive sprockets only. The conveyor gallery is sheeted with aluminium, and the roof is one single curved sheet.

Before closing on this item it may be of interest to mention several of the special features of this section of the plant.

(*a*) Each suction hose of each tower may be regarded as an independent unit with separate exhauster and cross conveyor so that in the event of breakdown of one plant, the other can continue to operate.

(*b*) Bunker level indication shows the filling of the collecting containers, and over filling, with the possibility of entrainment of material into the blowers, is eliminated.

(*c*) All parts subject to abrasion by the alumina and coke (bends, elbows, etc.) have been protected by a fused basalt lining.

(*d*) The movements of the booms (lifting, lowering, drawing in and out of the telescopic pipes) can be controlled from the operator's stand in the elevator tower as well as from the ship.

(*e*) The idlers on the conveyor have "maintenance free" lubrication, lasting for several years, provided by means of triple labyrinth seals and dust arrester grooves.

(*f*) All points of transfer in the suction unloaders and in the conveyor systems have dust control, and the extracted dust is again transferred to the material being conveyed.

(*g*) Sequence interlocking, electrical and mechanical "holdback" locking safety devices are provided and the coke storage silos are equipped with two sets of level indicators, the first set to signal and the second set to put the stopping sequence into operation.

Storage

A total of five silos are provided for the winter storage of alumina. The silos measure 65 ft. in diameter by 100 ft. high, with a capacity of 8500 tons each. A sixth silo (No. 1) is designed with feed points for filling alumina-furnace charging vehicles.

After the alumina leaves the belt conveyor it is discharged into a circular hopper and then passed for intake into the selected storage silo by means of low pressure air fluidized conveyors passing over the tops of the silos. The alumina may be reclaimed from any of the five storage silos and conveyed by similar trough type fluidor conveyors to a pump chamber for pumping into the No. 1 feeding silo.

The pumps also make use of the fluidizing principle by first fluidizing the alumina in the pumping tank for lifting the alumina by compressed air through conveying pipes and into the top of the feeding silo No. 1. Two sets of pumps are provided for this purpose each of which has a capacity for pumping 33 tons of alumina per hour. Two group control stations with mimic control diagrams are provided to cover all operations. One station provides the control for distributing the alumina to storage as delivered from the main conveyor and this situated at the top of silo No. 6; the other provides for reclaiming and discharge and this is situated on one of the base floors in No. 1 feeding silo.

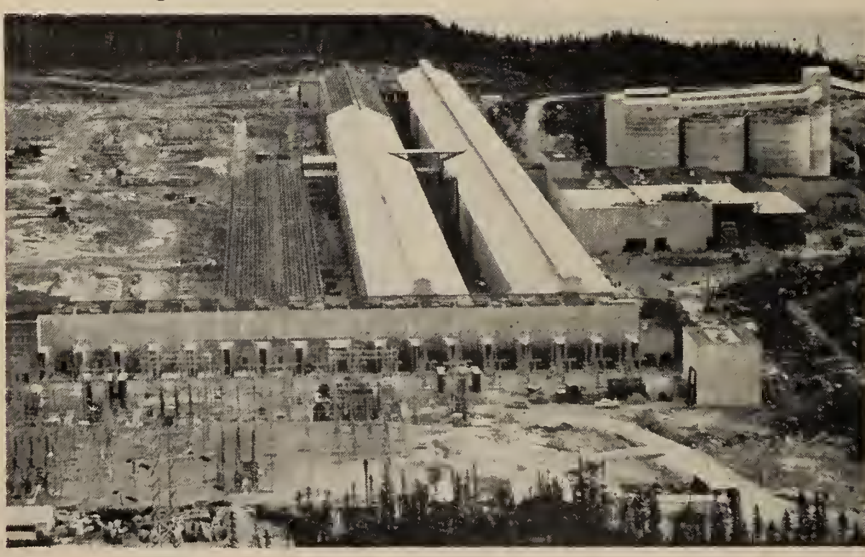
The timing of the various control operations is fully automatic with automatically operated compressor plant mounted in the basement of No. 1 silo immediately below the main control room.

As in the case of the suction unloader and the belt conveyor, the alumina storage and handling installation is provided with dust reclaiming plant for cleaning the process air before passing this back to atmosphere.

The distribution to the storage silos and subsequent handling of alumina is through equipment supplied by the British part of the successors to the original discoverers of the fluidizing principle. It may be of interest to mention that the installation at Baie Comeau is believed to be not only the largest of its kind, but apart from some minor applications in the cement industry, is the first supplied in North America.

Thus the unloading, belt conveying and alumina distribution to storage and reclaiming, form an integrated handling system under close automatic control with the addition of telephone communication between the dock, the conveyor, and the alumina and coke storage silos.

Fig. 3. General view of industrial site. Alumina silos at right, switchyard in foreground. Furnace rooms are 1700 ft. long. October, 1957.



Carbon Plant

It will be known that the reduction process for producing aluminium requires something like 0.5 to 0.6 lb. of anode paste for each pound of aluminium when using Soderberg electrodes. The above figures determine the capacity of the carbon plant and also illustrate that a carbon reduction plant must be regarded as a vital feature of a reduction smelter.

It should perhaps be mentioned that besides anode paste, the Baie Comeau carbon plant is designed to provide pot lining mixture for part of the lining of reduction cells.

The plant designed, engineered and erected specially for the Baie Comeau installation differs in a number of aspects from other conventional paste plants and it may be of interest to make some reference to these features which may be listed as follows:

(*a*) Operation is from central automatic control station.

(*b*) It is a continuous process with continuous mixers designed for the preparation of anode paste in briquette form.

(*c*) It is designed for the use of hard pitch in a molten state.

(*d*) The production train allows for the concurrent production of anode paste and pot lining mixture.

(*e*) The use of hydrotherm as a heating medium.

(*f*) The provision of raw material storage facilities for four to five months during the winter close of navigation.

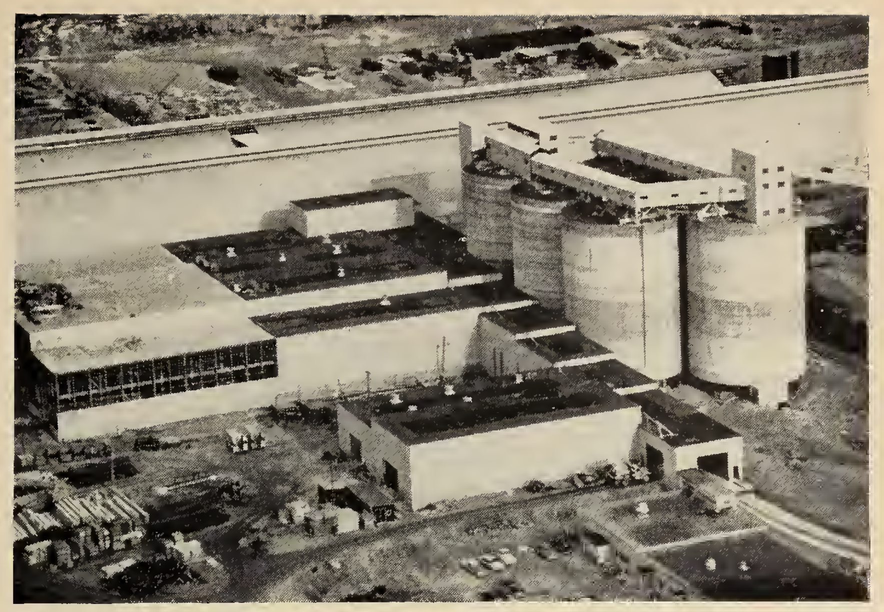


Fig. 4. Ancillary buildings—general workshops in centre. Ramp to central corridor at lower right. November, 1957.

Central Automatic Control

Since it is always the goal to find ways and means of automation, a few additional remarks on the central control arrangement may be of interest.

The control room, housing three different control boards with push-button electronic instruments and graphic control lights, represents the "brain" of the plant. These instruments indicate and record temperature, draft, bin level of storage and fraction bins, pitch level and temperature in melting and holding tanks, flow rate and quantity of pitch and grist for anode paste or lining mixture preparation. An annunciator panel indicates and informs the control operator of any abnormal conditions, and a graphic flow sheet gives the operator visual control by means of lights indicating the machinery in action and the direction of flow of the material.

All operational processes as described are performed by one operator, in addition to whom, four operator's helpers on the floor, one clerk, one general foreman and the superintendent form the complete operational personnel for the production plant, which is designed to give an output of 53,600 tons of anode paste per year and 2800 tons of pot lining mixture per year when working two shifts per day, five days a week.

Fig. 5. Completed wharf. November, 1957.

Continuous Process with Continuous Mixers

The preparation of grist as well as the preparation of anode paste is arranged for continuous operation.

The raw material, calcined petroleum coke, is first fed over the screen with the provision of three fraction separations in order to fill the first coarse fraction bins. As soon as the coarse fraction bins are filled the flow of the coarse fraction is automatically re-routed to the crusher surge bin where the coarse intermediate will be produced. Again, as soon as this coarse intermediate bin is filled an automatic re-routing to the fine crusher surge bin takes place. As soon as the fine intermediate bins are filled the overflow is routed to the mill feed bin for producing the fine fraction by means of airswept grinding. The product of the airswept grinding system does not change with the feed size, therefore such an overflow arrangement from the fraction bins toward the mill feed bin is possible.

By means of continuous scales the coarse fractions are rationed and a correct proportioning of fractions can be fed direct or via a heat exchanger and feed screws into the continuous mixer.

Simultaneous to this operation the molten hard pitch, at approximately 350° F., is controlled by metering pumps and flow meters and is fed to the continuous mixer. Here the final mixing and extruding takes place and the extruded paste is strung and cut to briquette size approximately 2 in x 2 in. x 3 in. by a cutting wheel, then cooled with water and conveyed to a briquette store by means of elevator and conveyor system.

Use of Hard Pitch in Molten Form

The hard pitch, which is delivered in 12 in. to 16 in. lumps, is transformed to a molten state in melting tanks which are provided with internal heating coils fed from the high temperature hydrotherm system.

Circulating pumps provide for the equal heating of the pitch within the melters which is then pumped from the melting tanks to large overhead holding tanks where the pitch is brought to its ultimate temperature before discharge by gravity, to be used for blending with the carbon grist fed via the continuous weighing scale for production of anode paste in the continuous mixer or into the batch mixers along with coke anthracite grist fed via a batch scale for the production of pot lining material.

Hydrotherm

Some mention of the heating medium used throughout the system for melting of hard pitch and for maintaining the temperature of the pitch in the holding tanks and process lines, the jacketing heating of the continuous and the batch mixers, etc., may be of interest. This heating fluid is pumpable between temperatures of 50° to 600° F. For the pitch melting operation hydrotherm is heated to 550°-580° F. for circulation in the melters. The heating medium has the advantage of being non-explosive and non-inflammable and is not poisonous. Other heating media such as steam would be more expensive due to the necessity for using high pressure to give equivalent heat transfer and, on the other hand, such media as oil which could give equivalent heat transfer rates would be dangerous and would introduce fire and explosion hazards at the temperatures needed. The hydrotherm system has been divided into a low temperature and a high temperature circuit where the high temperature system is used for pitch melting and the low temperature system is used for maintaining the heat of process lines and mixer jackets—the whole system being of a gravity and not a pressure type, arranged by means of an open expansion tank.

Fig. 6. View of a section of the townsite.

Hydrotherm fluid is highly penetrating at operating temperatures. This made it necessary to introduce a very rigid specification and control for jointing of the many thousands of feet of hydrotherm piping installed.

In the construction program, the erection of the carbon plant presented the greatest challenge to meeting the target dates. As the plant represented a completely new design the final designs of building steelwork and of the plant had to wait the near completion of the design of the system. Following manufacture and delivery of the steelwork it was mid-May 1957 before a start could be made on the erection of the building steelwork to be followed in early June with a start on the erection of the plant. In all, something like 1,850 tons of plant was involved, some of which had to be erected at elevations of up to 120 ft. along with 55,000 ft. of process pipe work, including about 2,500 valves of various sizes. As an indication of the intricate electrical installation involved it can be quoted that a total of approximately 200,000 ft. of cable was used with a large proportion of the electrical installations being to explosion proof specification.

Pot Rooms

As previously mentioned each stage is planned for the production of 45,000 tons of ingot per annum so that each stage has two pot rooms over 1,700 ft. long with the rectifier station running across the west end and the casting shop across the east end of the pot rooms. The pots are designed for 100,000 amp. operation and are vertical stub Soderberg type with 168 pots in each series or stage, comprising two rows of 42 pots in each building. It is not intended to give a description of the process, which will be well known to most of the readers. It can, however, be said that to stand up to the operating temperature of the molten fluxes and metal at about 1000° C. and in view of the highly penetrating characteristic of the cryolite flux it is necessary to protect and insulate the steel box comprising the cathode, first with a lining of refractory brick and then with the final lining of baked carbon block and a rammed carbon lining to completely seal the bath. The anode assembly is fully motorized to enable the distance between anode and cathode to be regulated to suit operating requirements.

Stubbing is effected by means of overhead travelling crane-mounted stubbing machines of French manufacture. These machines are of precision design arranged for automatic control of cross travel and extraction and can operate with an accuracy of 5 mm., the machines themselves being capable of exerting a torque up to 30 tons. The operation for extracting stubs is very similar to the extraction of a tooth in that the gripper is travelled to exact location above the stub to be withdrawn; the gripper is then lowered to bite the stub pin which is twisted through 90° and then extracted from the baked carbon forming the electrode. The carrier is then retracted along with the rejected stub which is placed in a carrier on the machine and following similar motions a new stub is inserted to rebake in the soft zone of the anode.

The overhead stubbing operation thus leaves a free furnace-room floor for crust breaking, metal-tapping, and anode paste replenishment vehicles. The tapping operation is by means of a large crucible mounted on a battery driven vehicle to run alongside the furnaces. The crucible carrier is provided with side crabbing, elevating, and tilting motions to enable the metal to be sucked from the furnace by compressed air ejector action. The crucible is then travelled to the casting shop where the metal is decanted into the holding furnaces.

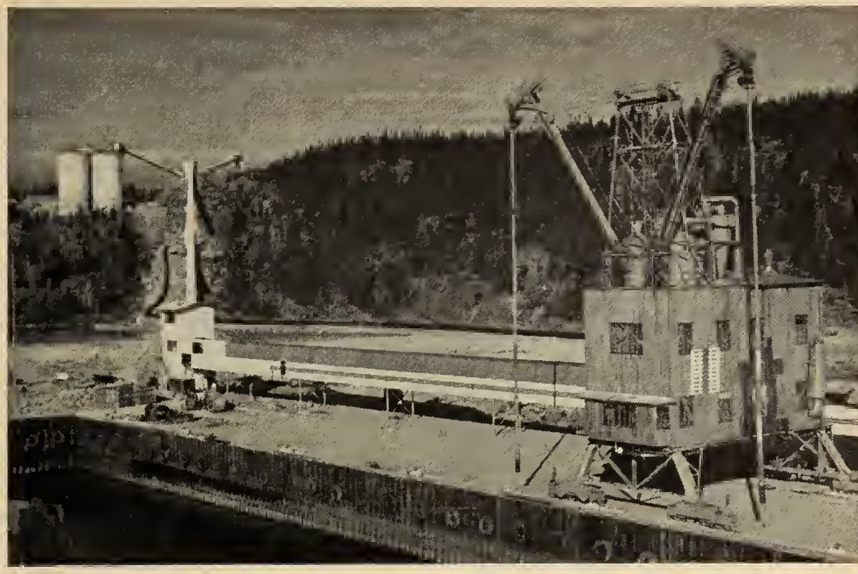
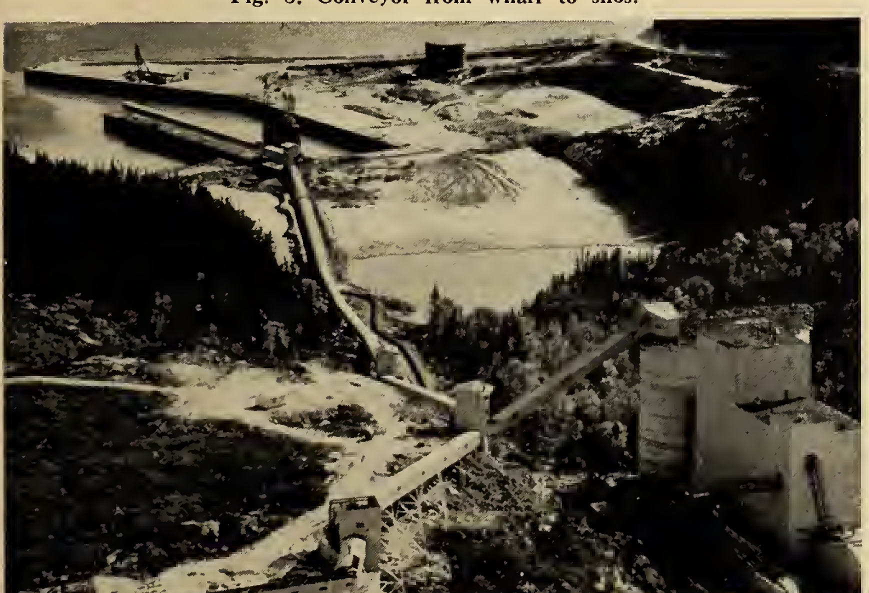


Fig. 7. Pneumatic unloader at right. Conveyor from wharf to silos.

One feature which may be of particular interest is the design and form of fabrication for the main 100,000 amp. furnace conductors. In all, approximately 3568 tons of aluminium bar is used for each furnace series. This material was received from the parent company in lengths up to approximately 50 ft. The largest section used for the cathode conductors measures 24 in. x 5 in. in section and is fabricated in the site workshops up to maximum lengths of approximately 80 ft. including the flexible risers to the anode conductors. To deal with the fabrication on site special machines were ordered for the jig drilling of many tens of thousands of holes together with the scalping, bending and slotting operations. It can be said that the fabrication of the complete production series involved a total of approximately a quarter million operations comprising the drilling of 2 in. diameter holes, slotting, scalping for contact faces, bending, welding, tapping, sawing, etc. Some tens of thousands of welds had to be made and a special production line was installed for this purpose. Much of this welding required a special technique, involving as it did the welding of steel to aluminium, the welding of the packets of flexible conductor for the anode connections, and the welding of the heavy section conductors measuring up to 24 in. x 5 in. in section. For stage II, bars of the same section and length are now being produced at Baie Comeau by a continuous horizontal casting process, and we think it can be claimed that these are the first of this type to be used on the American Continent. To transport these cumbersome prefabricated bars from the prefabricating shops to the potrooms called for some ingenuity in the design of handling and carrying jigs.

Fig. 8. Conveyor from wharf to silos.



Casting Shop

As already mentioned the liquid metal from the reduction furnace is carried to the casting shop for blending, for additions or other treatment necessary before being cast into ingots, rolling slabs or conductor bar. These holding furnaces are oil fired and are mainly of lip axis tilting design for direct feed into the ingot casting machines. Machines are installed for the production of chill casting of 25 lb. and 50 lb. ingots, and semi-continuous machines for the production of rolling slabs, extrusion billets, and wire bars up to a maximum size of 84 in. x 9¾ in. rolling slab. In addition, a horizontal long casting machine is installed for the production of aluminium bar as previously described and we are now able to say that this machine is in regular operation.

Power Supply

The power supply for stage I and part of stage II is from the Manicouagan Power Company, and Hydro-Québec have contracted to supply the balance of the power needed for stage II and further power for stages III and IV. The power from Manicouagan is at present carried by a single tower, two-circuit 161 kv. transmission line approximately eleven miles long, to the C.B.A. smelter. One circuit is sufficient for the two stages, the other one may be regarded as a spare. With the ultimate four stage development a second tower carrying a single circuit will be installed so that during all stages of development a complete spare circuit will be available.

The two 161 kv. lines from Manicouagan terminate in an outdoor switchyard at two 1200-amp. air-blast circuit breakers which feed 161 kv. duplicate busbars. Each pot line is fed from the 161 kv. busbars by a 115 Mva. 161/33/13.2 kv. transformer. The secondary winding of this transformer feeds the pot line via a 33 kv. regulating transformer which is provided with off-load tap connections and on-load tap changing equipment designed to give a wide operating voltage range. The 13.2 kv. tertiary winding serves the works distribution supply for subsidiary power and lighting. Standby 33 kv. busbars are provided which can be fed from a spare 115 Mva. 161/33/13.2 kv. transformer together with a spare regulating transformer which can be used to serve as a standby for any of the ultimate four pot lines.

Pot Line D.C. Supply

For each pot line 100,000 amp. at 850 volts d.c. is required. This is provided by pumpless steel tank multi-anode air-cooled mercury arc rectifiers. The specification rating is for electro-chemical duty designed to a British standard specification which is identical to American standard C-34.1 — 1949 electro-chemical service rating. The equipment consists of a total of 144 rectifier tanks per pot line grouped to give 8 units—each unit being rated at 12,150 kw., 850 v., 14.285 amp. which enables the full pot room load to be carried on 7 units indefinitely, although under normal operation all 8 units are kept in circuit to provide for operation at maximum efficiency. Each unit thus comprises 18 pumpless steel tank rectifiers working in parallel which incorporate air cored anode reactors to ensure good load sharing between the rectifiers operating in parallel. These reactors are also designed to limit the maximum value of fault current to a safe value in the event of an arc-back. Special mention is made of this point as this system of control is not generally used by American and Canadian manufacturers who have hitherto relied on a.c. and d.c. switchgear to clear such faults.

Mention has been made of the off-load tapping points provided on the main stepdown transformer to facilitate voltage variation of the pot line. These off-load tappings are designed to give alternative outputs of 25.5 kv., 19.0 kv. and 14.7 kv. in addition to the normal 33 kv. operating voltage. The series regulating transformer provides for 21 position "on-load" tap change to give plus and minus 14½% buck or boost on the intermediate voltage. The above combination on the regulating transformer and offload tappings on the stepdown transformer provides continuous control of d.c. between 240 volts and 850 volts and control grids on the rectifiers are used to provide the fine control needed between on-load tapping positions. Likewise, this grid control of the voltage provides a means for load balancing between the eight separate groups and for short time voltage reduction required from any voltage down to zero for use when picking up or dropping load.

Fig. 9. Alumina silos under construction.

It could be mentioned here that no difficulty or trouble was experienced in operating the complete rectifier installation continuously over a long period at 100,000 amp. with busbars short-circuited during the initial drying and commissioning period.

Pot line control is by means of a master grid control phase shifter operating on all eight units in parallel. In addition to this each unit has its own grid control phase shifter to permit load balancing between units. Protection against arc-back is provided by a combination of reverse tripping d.c. high speed circuit breakers and arc suppression operating on the rectifier control grids. The arc suppression is actuated by a high speed mechanical relay triggered by reverse current only. This relay has an operating time of 1 millisecond. Each unit has its own 33 kv. a.c. circuit breaker and the starting sequence for the unit follows automatically upon the closing of the circuit breaker. In addition, a master 33 kv. pot line circuit breaker is provided for controlling the a.c. supply to a complete pot line equipment. This breaker permits change over to be effected from main to standby, stepdown transformers on load.

The rectifiers are air cooled with an individual propeller fan for each rectifier. Cooling air is drawn into the rectifier station basement by separate fans mounted in the outer walls of the building and adjustable louvres are provided in the ducts to these fans and outlet louvres in the roof above the rectifiers provide for temperature control of the cooling air. To cover the wide range of ambient temperatures from minus 40° C. to plus 32° C. both the rectifier and substation fans are also equipped with two-speed motors. The whole rectifier equipment is remotely controlled from a central control room and all protective relays are installed in an annex to this control room. Direct telephone and radio communication has been provided from the control room to the Manicouagan power station.

It may be of interest to repeat some of the features of this equipment which differ from the more usual North American installations:

(*a*) The use of multi-anode pumpless rectifiers instead of single anode ignitrons.

(*b*) The use of arc suppression with cathode high speed circuit breakers for backfire protection instead of anode breakers.

(*c*) The use of cored anode reactors to limit arc back current.

(*d*) The use of air cooling instead of water cooling.

(*e*) A wide range of voltage control by on-load tapping with a limited amount of grid control.

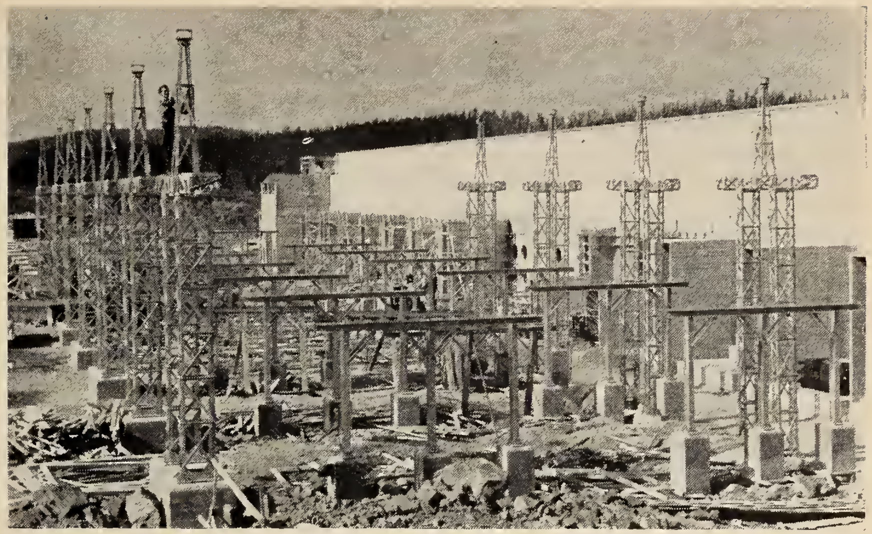


Fig. 10. Switchyard under construction.

Works Distribution Supply

The works distribution is at 13.2 kv. The supply is taken from the main transformers in the outdoor switching yard and brought into No. 1 main substation located near the rectifier station from which a 15 Mva. 13.2 kv. ring-main is taken to supply other works distribution substations throughout the plant and at the dock. These substations transform to 550 volts, 3 phase a.c. for secondary distribution and further local transformers fed at 550 volts provide for the 110 volt lighting and service receptacle connection points.

CONCLUSION

In conclusion, the following notes may be of interest and serve to give a general indication of the rate of plant erection and construction and to give an outline of the main plant erection contracts.

The main electrical contractor made a start in January 1957, building to a peak labour force of 330 in October 1957.

Mechanical plant contracts covered the construction of furnaces and the erection of plant and were placed over the period March to May 1957. An overall peak labour force of approximately 950 was reached on plant erection during August 1957.

Much has been achieved and much has been learned in the way of economic and efficient planning during the period of construction March 1957 to the completion, in April 1958, of all that is involved in stage 1.

These points, although well known, are often difficult to achieve, and it may be worth while to make special reference to the following essentials:

(*a*) The need to keep down the short-term peak labour force to a minimum, as accommodation facilities under the conditions that usually prevail with such a project are costly.

(*b*) To keep temporary construction electric lighting and power wiring to a minimum by earliest possible installation of the permanent electric distribution and permanent lighting installations.

(*c*) Also, as far as practicable, to plan for the earliest possible installation of permanent compressed air services to assist construction operations.

(*d*) The need for adequate and strategically located undercover storage.

(*e*) The steady and sequence-planned delivery of construction material to avoid expensive rehandling.

(*f*) The early and complete planning and programming must be regarded as an essential to the success of the project as the period of construction provides neither the time nor the right atmosphere for working changes to technical design and the engineering supervision is required out on the job and not at the desk and drawing board.

(*g*) Finally, to effect earliest possible erection of permanent cranes as, in common with most projects of this magnitude, there never seem to be enough cranes during the peak construction period. In all, and under the two-stage development, including 8 stubbing cranes, rated at 50 tons, one 100-ton crane in the transformer maintenance building, one 100-ton and one 50-ton crane in the furnace repair departments, one 100-ton stiff-leg derrick at the dock for unloading the heavy transformers and one 5-ton high-speed luffing crane at the dock. The importance of adequate craneage is emphasized and to illustrate this need it can be stated that over the period covering the completion of stage 1 development, the handling and erection of plant and equipment alone has involved the placing of approximately: 13,000 tons of furnace steel work; 8,500 tons of furnace refractory bricks and carbon blocks; 3,500 tons of aluminium conductor; and 6,000 tons of electrical plant and equipment, material unloading, conveying plant, cranes, compressors, machine tools and carbon plant crushing, grinding elevating plant, boiler plant, etc.

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Construction of the project was under the direction of the authors. Assistant construction project manager was A. McDougall, M.E.I.C.; resident engineer, V. M. Wallingford, M.E.I.C.; and assistant resident engineer, B. A. Kelly, M.E.I.C.

Aluminium Smelter Dock at Baie Comeau

T. A. Hughes, M.E.I.C.
Co-ordinating Engineer, C. D. Howe Company Limited, Montreal

V. M. Wallingford, M.E.I.C.
Resident Engineer, Canadian British Aluminium Company Limited, Baie Comeau, Que.

Read at the 72nd Annual General and Professional Meeting of the Engineering Institute of Canada, Quebec City, Que., May 1958

As OUTLINED in a paper (on page 41) in this issue, large quantities of raw materials for making aluminium have to be received by ship, and the bulk of the aluminium produced is also shipped by boat. Hence, an all-weather dock with adequate unloading and loading facilities capable of handling ocean going vessels is of prime importance and the location of a suitable dock site was one of the prime factors influencing the selection of the smelter plant site. This paper describes the design and method of construction of the dock.

Selection of Site and Harbour

Considerable hydro-electric power is required for the smelting of aluminum. This, coupled with the desirability of locating the smelter as near the mouth of the St. Lawrence River as practicable (so that shipping distances to and from the United Kingdom, which is the principal market for the ingot produced by the smelter, would be as short as possible), suggested that the site should be located on the North Shore of the St. Lawrence.

Good natural harbours are few and far between on this rugged shoreline and the site finally selected was two miles north-east of the paper mill town of Baie Comeau, which is approximately 430 miles downstream from Montreal and 120 miles upstream from Seven Islands. Though not served by any railroad system, Baie Comeau did possess an existing dock capable of berthing 10,000 ton vessels, was linked to Quebec City by a secondary road, and was on a scheduled air line service. These facilities were of very great assistance during construction of the project.

The actual site selected for the dock was a small bay named Baie du Moulin, part of the larger English River Bay bounded at the north east by St. Pancras Point. (Fig. 1). Although the surrounding country is rugged and rocky, preliminary investigation, later confirmed by geophysical investigation, indicated that a sheet piled dock could be constructed in the bay without having to pin the steel sheet piling to rock and would involve the dredging of an economical amount of the original bay bottom.

Use of some of the heaviest and strongest steel sheet piling ever used in Canada enabled the new dock for C.B.A. at Baie Comeau to be designed, constructed and equipped ready for use in 22 months, which period included the cold winter of 1956-1957. The dock face is believed to be one of the deepest of its type ever constructed in an essentially cohesionless river bottom material without constructing a relieving platform behind the dock.

The maximum tide range in the bay is 15 ft. 0 in.

Requirements for the dock were that two sheltered berths were required initially, each 550 feet long, providing not less than 30 feet of water at low tide, and two future additional berths were desirable though not essential. The two initial berths would be equipped with loading and unloading equipment.

Siting of Dock

The prevailing winds in this area are off-shore but south-east and north-east storms do occur periodically each year, and it was therefore essential that a breakwater be provided, primarily as protection against south-east storms. It can be seen from the general layout (Fig. 1) that only a limited reach of open water would exist from the north east due to the high rock configuration that existed on the north side of the bay as far as St. Pancras Point. Figure 2 shows the layout adopted for the dock, and also indicates that the breakwater enabled a third general cargo berth to be constructed at a small additional cost. The layout provides for a fourth berth on the north side of the jetty by carrying out additional dredging together with construction of an inshore wing wall. If a fifth berth is required, a further slip can be constructed north of the existing one. Such a slip would not, however, be as protected from south-easterly storms. The present slip is well protected by the breakwater; from the western end of the slip, no open reach of water is visible.

In an average year it is anticipated that the shipping season need be closed only from mid-January to the end of March, due to ice conditions at Baie Comeau itself. With specially-designed ships (which are a distinct possibility for St. Lawrence traffic within 10 years) navigation to Baie Comeau would be possible almost all year round providing the Cabot Straits and similar areas were kept open by ice-breakers, and regular air reports on movement of ice were available. For the present, arrangements have been made to store five months supply of incoming raw materials and processed metal, to cover the period when ocean going vessels do not normally enter the St. Lawrence River and to provide a reasonable reserve.

Type of Dock

Ice movement during winter months restricts the use of open type docks on the North Shore. The choice of type of dock wall was therefore limited, and steel sheet piling was selected as being the most economically suitable for the conditions at the dock site. Due to the depth from top of dock to dredged bottom of 54 ft. 3 in. it was necessary to use very heavy piling. By careful selection of filling material behind the dock and using the heaviest section of piling available at the time it was possible to design the dock without a relieving platform. The original section of pile called for was Larssen No. 6 with a section modulus of 78.12 in.^{3} using high-tensile steel with a yield point of 51,520 p.s.i. and a working stress of 30,000 p.s.i. The pile lengths were 80 ft. 0 in. generally, reducing in increments to 48 ft. 0 in. at the south end of the breakwater where the sheet piles act as a cut-off only. The 80 ft. 0 in. length is about the maximum that can be rolled in the heavy section and approaches the maximum that can be handled by ship; in fact very few ships can handle this length in any quantity, which called for careful scheduling of deliveries from the suppliers.

The piles were rolled in England, and it was found impracticable to produce satisfactory piles of the heavy section in high tensile steel, as a large number of cracks developed, principally at the sharp bends, and the piles were very difficult to straighten. The specification was therefore modified and so-called medium tensile steel having a minimum ultimate strength of 73,920 p.s.i., a guaranteed minimum yield of 42,000 p.s.i., and a working stress of 25,000 p.s.i. was used. No particular problem was encountered in rolling this heavy section with this grade of steel.

Hydrographic and Soil Investigation

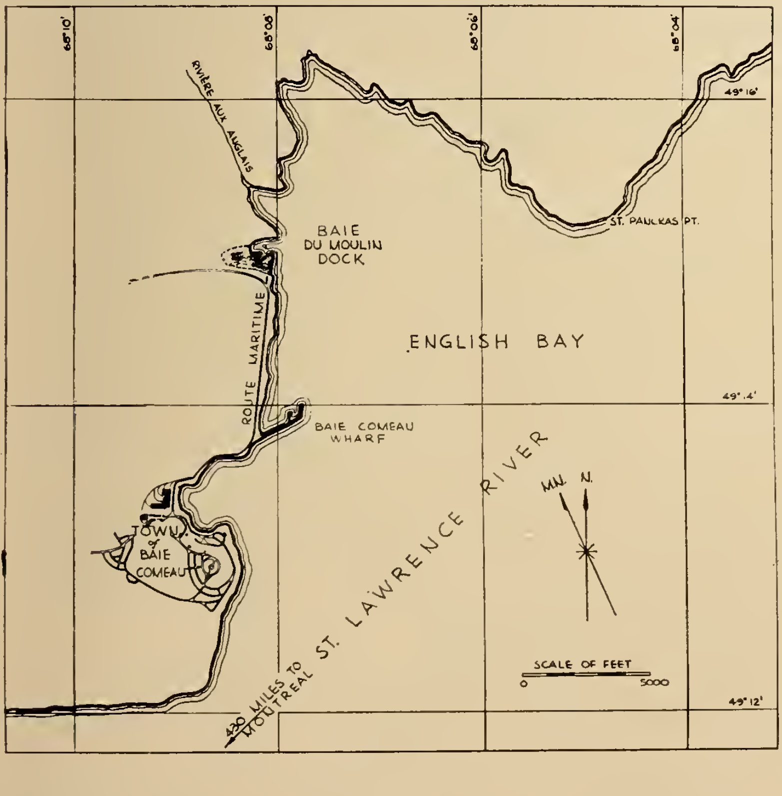
Preliminary soundings of the bay were obtained by the consulting engineers in the fall of 1955 and the underwater soil investigation program was awarded to a specialist company on a unit price and fee basis. In order that the soil investigation could proceed, a preliminary layout of the dock was prepared on the basis of visual site conditions and a pattern of boreholes laid out at the western end where bedrock was likely to be nearest the surface. Information from the first boreholes was passed to the engineer's office immediately it was obtained and the dock layout adjusted so that the necessary penetration of the sheet piles could be obtained at the inshore end. A further pattern of boreholes, penetration tests and wash borings was then laid out along the profile of the proposed dock face and a further series of boreholes and penetration tests in the area to be dredged.

Specifications called for borings to be taken along the dock face to 65 feet below L.W.O.S.T. or to rock (or dense boulder layer) whichever was higher, and in the area to be dredged to a minimum of 45 ft. 0 in. below L.W.O.S.T. Where refusal was encountered at an elevation higher than minus 65 ft. 0 in., the strata was diamond drilled to a depth of 10 ft. 0 in. to establish whether it was bed rock or a layer of boulders. A total of 15 BX size boreholes were put down with accompanying dynamic penetration tests, 8 additional dynamic penetration tests and 7 wash borings.

The underwater investigation was carried out with a machine drill rig mounted on an 80 ft. 0 in. x 30 ft. 0 in. scow. The scow was a little smaller than desirable but was the only size available economically at the time. The borehole locations were determined by normal survey methods using a base line on the south shore of the bay. Particular care was taken in anchoring the scow in position; secure positioning of a floating rig in tidal water is often the most difficult feature of the boring operation. That the late fall of the year is not the best time of year to carry out underwater ground investigation along the North Shore was confirmed, and considerable time was lost due to weather conditions. This is something to be considered carefully in assessing the probable cost of such an investigation. In this case the construction schedule for the dock could not have been met by delaying the investigation until the spring of 1956.

The borehole investigation indicated that the dock site was, in general, covered with loose, dark grey, organic silt underlain by sand varying from loose to very dense, dependent upon location and depth and containing gravel with increasing depth prior to reaching boulder layers or bedrock. As is to be anticipated resistance of penetration tests at individual boreholes varied considerably but in most cases a minimum value of 20 blows per foot was recorded at the dredged level, and if certain penetration tests were representative hard driving for piles could be expected in certain areas. From the results of the borings and other tests it was estimated that the silt had wet and submerged weights of 110 and 48 pounds per cubic foot and an earth pressure coefficient of 0.35 after dissipation of pore pressure induced by the rock infill material placed over the silt following driving of the piles. The sand and gravel was estimated as having an average angle of internal friction of

Fig. 1. Location of dock.



35°, and wet and submerged weights of 125 and 63 pounds per cubic foot respectively.

At the west end of the bay where original bay bottom was highest, the silt layer was 10 to 15 deep. To avoid excessive pressure on the sheet piled wall, it was considered advisable to remove approximately 8 ft. 0 in. depth of the material for a width of at least 15 ft. 0 in. on the inshore side of the sheet piling for the critical area, the area so excavated being filled with quarry rock after the sheet piling was driven. Actual construction timing enabled the silt to be removed by the dredge.

The above information confirmed that a steel sheet piled dock could be constructed and that no rock dredging would be required. Some boulders too large to be disposed of by the suction dredge by normal pumping would be encountered.

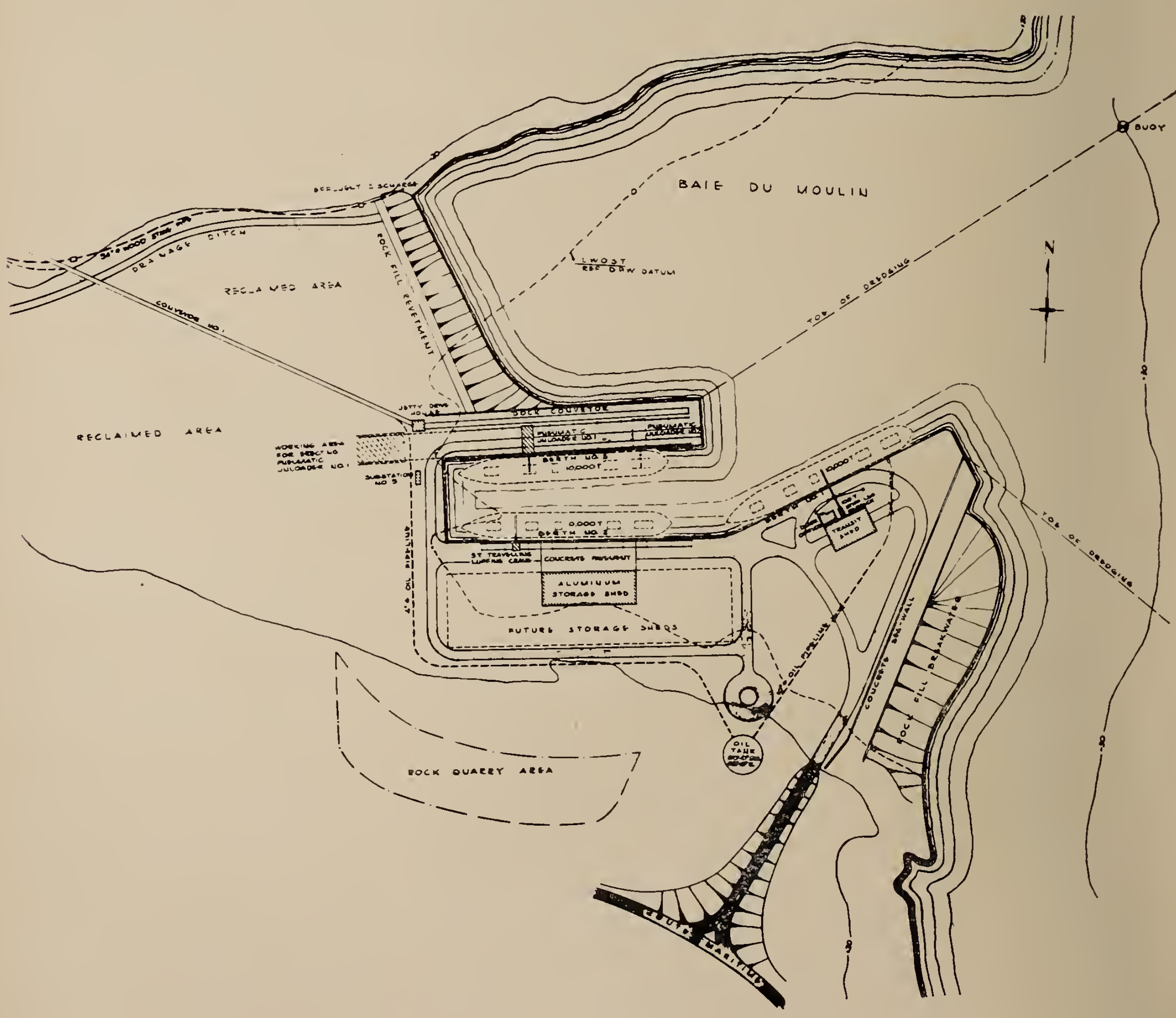
Dock Construction

The decision to build the dock in Baie du Moulin was taken in October, 1955, and all planning was based on handing the dock over for operations by August, 1957. As it would not be practical to complete designs, call for bids and commence construction before the spring thaw of 1956, in order to safeguard material supplies and to avoid delays in starting construction, all main materials including sheet piles, wales, tie rods, and large bolts and washer plates were ordered by the owner against competitive bids, and definite delivery dates established. When the contract was awarded these materials were handed over to the dock contractor.

Main quantities of materials ordered were: steel sheet piling, 7,100 tons; tie rods, couplers, and miscellaneous steel, 1,300 tons.

A typical cross section of the loading dock is shown in Fig. 3. Each of the 80 ft. 0 in. long Larssen No. 6 piles weighs 6.75 kips. Tie rods spaced every fourth pile are 3⅜ in. diameter with ends upset to 4 in. diameter. The individual lengths of tie rods were agreed with the supplier to suit the size of rolling billets available. Hexagonal sleeve nuts were used to connect adjoining lengths of tie rods, these being cheaper than turnbuckles. A small inspection hole was provided at the centre of each sleeve nut to observe that the nut had been tightened sufficiently. The tie rods did not pass through the web of piling, as has been the more common practice over the years, but were secured to the lower wales. This has the disadvantage that the stress from the tie rods has to be transferred via

Fig. 2. Layout of dock.



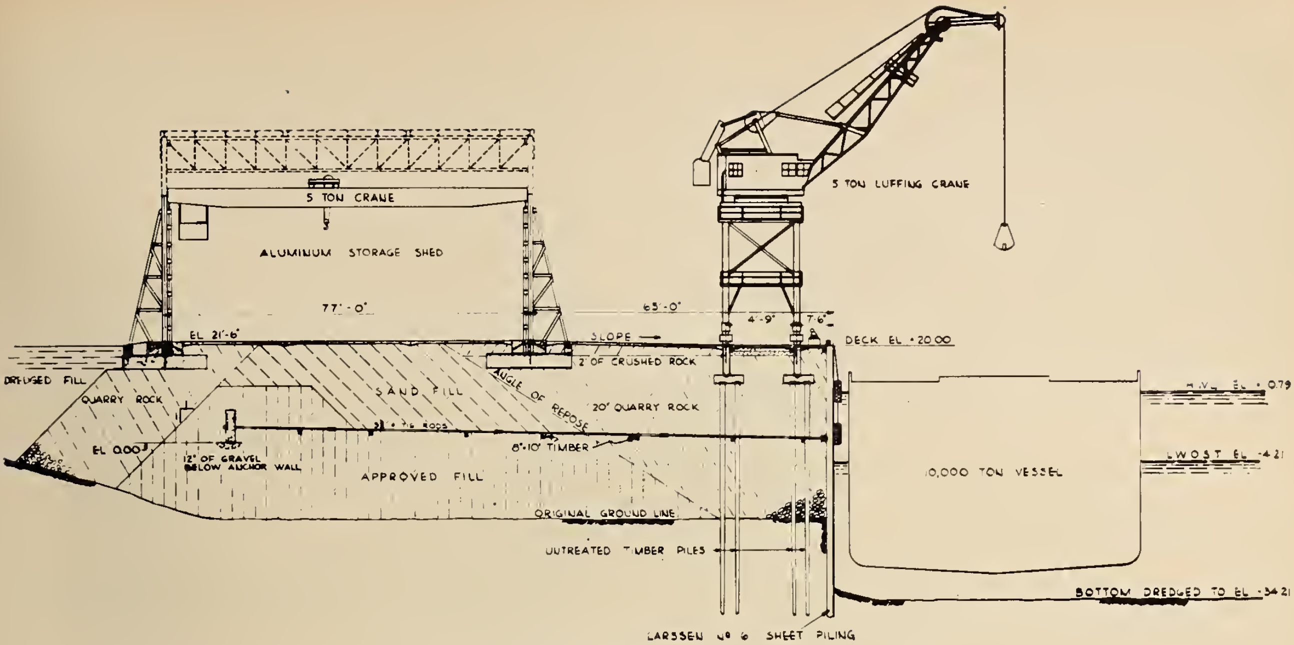


Fig. 3. Typical cross section through loading dock.

the walers to the piling by substantial bolts but it was considered desirable to avoid burning large diameter holes in the medium tensile steel piling. On the credit side placing of tie rods is also simplified; with the system used all work can be done from one face of the piling.

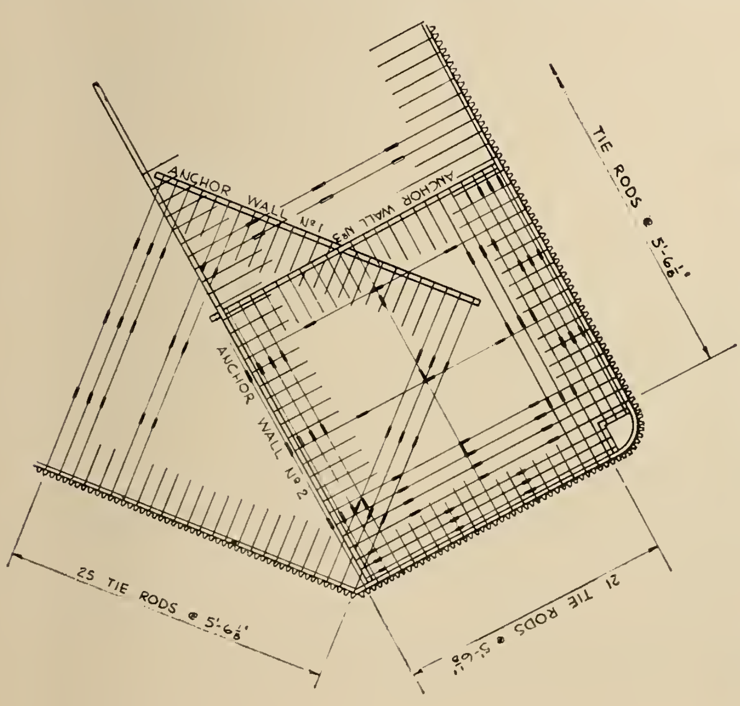
The upper waler in conjunction with the 1 in. thick coping plate stiffens the top of the piling and assists in distributing berthing stresses. The waler is also used in the final lining up of the top of the piling. Where locally the final line of piling is not as straight as it might be, there is a natural construction tendency to run the coping plate straight and to hide "waves" in the piling when viewed on plan. Caution should be exercised in permitting this practice; too much overhang of the coping plate beyond the face of the piling can cause considerable damage to ships.

From the typical section of the dock it can be seen that rock fill is placed so that, other than dock surcharge loads, the only load on the piling above original river bottom is from the broken rock fill. Due to the substantial depth from top of dock to dredged bottom (54 ft. 3 in.), such a procedure was necessary to keep the stress in the sheet piling within acceptable limits. It is believed that this dock is one of the deepest ever built with steel sheet piling driven into an essentially cohesionless material, without a relieving platform behind the dock.

Nose of Breakwater

Considerable thought was given to the shape and details of construction of the nose of the breakwater, and the final solution shown on Fig. 4,

Fig. 4. Left: Arrangement of tie rods at nose of breakwater. Below: Tie rods at nose of dock (before tightening).



though not the ideal shape, was considered to be the most practical. The proposed schedule of construction indicated that this nose would be constructed during a period when storms were quite probable and it was essential to ensure that steel sheet piling, when driven, could be tied back with the minimum of delay. It can be seen that there are three levels of tie rods in certain areas, and the anchorage walls were detailed so that the successive layers of tie rods were higher than previously placed ones.

Fig. 5. Construction of breakwater.

Anchor Walls

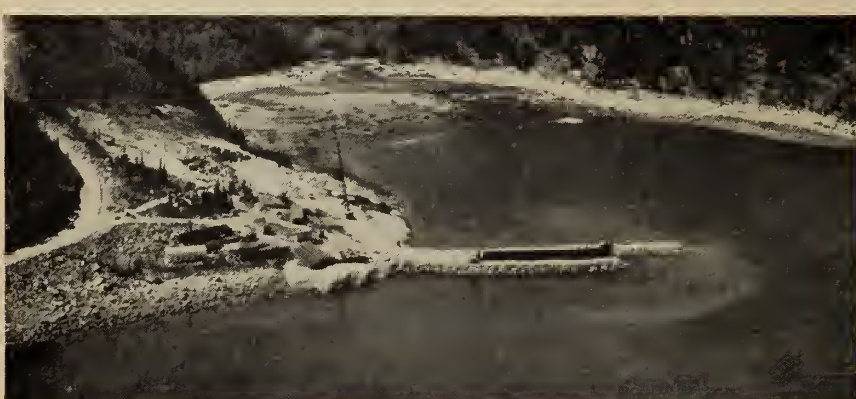
Figure 3 indicates that for berths 1 and 2, tie rods were inclined slightly upward from the face of the dock to place the base of the anchor wall as high as practical, so that concrete work could be done largely in the dry in low water periods. The initial plans and specifications called for the anchor wall to be a continuous *in situ* wall. Towards the late fall of the first year of construction it was found difficult to obtain satisfactory results, due to air and water temperatures, and the contractor was permitted to precast the walls in approximately 11 ft. 0 in. lengths, each precast wall anchoring two tie rods and weighing 23 kips. The size of each wall was determined by the handling capacity of the contractor's cranes and by the tie rod spacing.

Award of Dock Contract

Competitive bids were invited during February 1956 on a unit price basis against an estimated bill of quantities prepared by the engineer. No construction method was specified, and contractors were permitted to adjust the quantities of fill material behind the dock to suit their construction method, subject to the approval of the engineer. Such adjustments were taken into account in summarizing the bids received prior to awarding the contract. One point of interest regarding fill material is that the contract required the contractor to install a weigh scale at the dock and all fill material, by classification, was paid for by the ton. This system worked well, and was fair to both owner and contractor as it is difficult to forecast how much settlement of fill material into the original river bottom will occur. Some loss by tidal action is also inevitable.

The contractor was required to commence construction of the dock at the breakwater and to complete steel sheet piling as far as the northwest corner of the slip by the end of 1956, thus providing two berths, and to complete the entire dock except for surfacing by June 15th, 1957.

Fig. 6. Breakwater construction showing sheet pile cut-off.



Breakwater Construction

Work commenced on site in March, 1956. During the winter of 1955-1956, a road a little less than a mile long had been constructed along the shore to the dock site under separate contract giving direct access from the town of Baie Comeau and from the existing paper company dock.

A quarry for the rock fill was established in the hill immediately south of the dock, and with the contractor's cooperation it was worked in such a way that on completion it provided a reasonably level bottom approximately 8 ft. 0 in. above the top of the dock thus providing useful additional future building space.

Rock dumping for the breakwater began immediately, but no attempt was made to achieve the flat slope on the river side; the profile of the breakwater was adjusted so that the rock was dumped to its natural angle of repose (about 1 in 1 to 1 in 1¼) and the slope allowed to flatten under the action of the waves. (Fig. 5). During quarry operations, the larger stone obtained (3 tons and over) was stockpiled to be used later as armour stone on the breakwater. Due to the folded and fissured nature of the natural rock (mainly granite gneiss) very large armour stone is not obtained by normal blasting methods in any appreciable quantity. To date the size of armour stone obtained has performed satisfactorily. It is, however, anticipated that local wash-out may occur under severe storms, which is the reason the steel sheet piling has been carried as far south along the breakwater as bedrock levels permitted, to act as a cut-off. (Fig. 6).

Dock Construction

When the breakwater reached the point where steel sheet piling commenced, the general construction method adopted, except for the jetty section, was as follows:

(*a*) A rock dumped causeway was constructed inshore of the line of steel sheet piling, except for the south end of the breakwater where the initial causeway was constructed on the river side of the steel sheet piling to provide more protection to free standing piles, top width of causeway except at turning points being about 24 ft. 0 in. at elevation 12 ft. 0 in. It was specified that the toe of this causeway be kept a minimum of 10 ft. 0 in. from the face of the piling line. The quarry run rock contained sufficient fine material that no special surface treatment was required to give a reasonable construction trucking surface. When driving of sheet piling was sufficiently advanced an additional causeway was constructed from shore to the junction of berths 1 and 2 enabling the construction causeway to be advanced west along berth 2 and north-east towards the nose of the dock. (Fig. 7).

Fig. 7. Aerial view of dock construction, October 1956.

Fig. 8. General view illustrating placing of tie rods and fill material.

These causeways formed a work road from which the sheet piles could be pitched and driven. This latter work was done by a 3½ yard Lima 1201 assisted by a Lima 802. The 1201 was fitted with a 105 ft. boom and 30 ft. jib. Piles were pitched generally in panels of 8 or more and guide frames were supported from temporary timber piles. Driving was done using either a McKiernan Terry 10B3 or Vulcan 50C, steam for the hammers being provided by 100 h.p. oil-fired boiler, supplemented where necessary by vertical coal-fired boilers. Driving conditions varied considerably but in general were hard. In many instances resistances of 50 blows per inch and more were obtained. Locally, as might be anticipated in such a bay, obstructions were encountered in the form of boulders. These were, wherever possible, moved or broken by jetting, blasting or other means. In isolated instances it was found to be not economically possible to move these obstructions and, provided a reasonable penetration had been obtained and adjoining piles had full penetration, those refusing on such obstructions were cut off.

Fig. 9. Precast anchor walls in position.

In the appendix to this paper is tabled the relative proportion of time spent in a 35-day period on pitching and driving when driving conditions were very hard. Also given is a breakdown of lost time.

The steel piling did not drive to the exact theoretical dimension. Whilst dimensions of individual piles conformed to rolling tolerances, panels of piles when driven were slightly shorter than the theoretical distance for the number of piles in the panel. For the whole dock the calculated requirement was 2,300 piles whereas 2322 piles were actually driven. The number of tie rods used also increased proportionately.

(*b*) Installation of lower and upper waler systems followed closely behind the driving of steel sheet piles. Holes for the bolts securing the walers to the piling were burned using a guide template and very neat holes obtained. Walers were delivered with a shop coat of paint to give a degree of protection during storage. No additional protection was provided once they were in place. When ordering bolts and washers for securing walers to the piles it is necessary to include for a reasonable allowance for the losses of bolts and washers dropped into the water.

(*c*) Concurrently with construction of item (*a*) an embankment was constructed inshore up to the underside of the anchor wall. Selected approved fill material was used, in this case a mixture of quarry run rock and gravel. It is important to select a material or combination of materials which will stand to a fairly steep slope with the rise and fall of the tide and with a minimum of wash-out, otherwise fill quantities become very large.

(*d*) When a sufficient length of steel sheet pile wall had been driven the adjacent length of rock causeway was excavated to a little below tie rod level, see Fig. 8. The rock material excavated was used to fill the area between the causeway and the sheet piling which had already been tied back, or if construction sequence required it was blended with gravel and used in areas where selected fill material was specified. Precast anchor walls (Fig. 9) were placed concurrently with this operation and timbers placed on the rock fill, packed to correct level ready for tie rods to be placed.

Since the tie rods were located only 4 ft. 0 in. above low water level, all tie rod placing had to be very carefully scheduled with the tides, due allowance being made to cater for neap tide periods when tie rod placing was not feasible.

(*e*) With the tie rods in position, sufficient fill material was placed over the anchor walls to enable the tie rods to be made taut. The remaining area between the anchor wall and the piling was then progressively brought up to grade with the specified fill materal working from the anchor wall towards the dock face.

Permanent Equipment

The following equipment was to be installed.

(*a*) On berth 1, a 120-ton derrick.

(*b*) On berth 2, a 5-ton luffing crane.

(*c*) On berth 3, two pneumatic unloaders for discharging alumina and petroleum coke to a receiving conveyor gallery extending almost the whole length of the jetty and forming part of a conveyor system to transport these materials to storage bins and silos at the smelter site.

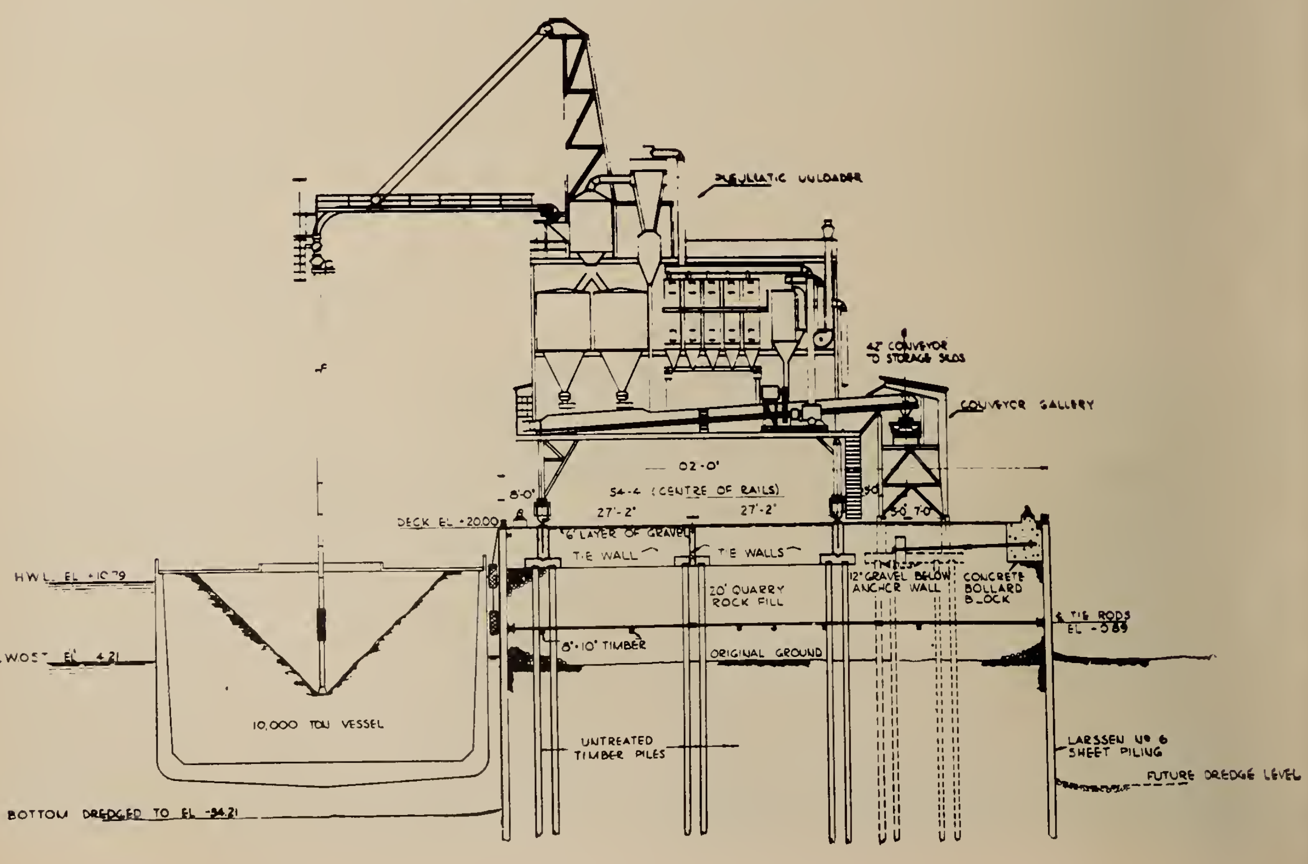
Foundations for the above were all supported on timber piles.

Timber Piling

Concurrently with the driving of steel sheet piling, timber piling for equipment foundations was driven from floating equipment. Timber piles were 60 ft. long, untreated Class "C". Considerable difficulty was encountered in driving these piles to the required penetration and location in the initial stages. It is believed that earlier and more extensive use of correct jetting methods might have simplified this problem. It was essential to obtain full penetration of these piles to distribute as much as possible of the load from piles close to the sheet piling below dredged level.

Both McKiernan Terry No. 7 and 9B3 hammers were used in driving the piles dependent upon the hardness of driving. Jetting in areas where very hard driving was encountered proved beneficial but at one stage presented a problem as some of the hardest driving coincided with a spell of cold weather resulting in freezing up of jetting equipment. In one area good results were obtained with the use of a steam jet. The very hard driving in certain areas is attributed primarily

Fig. 10. Typical cross section of jetty.



to a layer of very dense sandy silt approximately 20 ft. below low water. During the dredging operations in the slip itself when this layer was encountered, it was found impracticable to remove it to final dredged level by suction dredge, and the final dredging had to be completed by dipper dredge. A similar material was encountered locally on the smelter site and it is of interest to note that in its undisturbed state it could not be excavated with a 1½-yard machine equipped with either drag line or back-hoe equipment.

The maximum design load for the timber piles was 25 tons. Actual spacing of piles was selected to be a multiple of the tie rod spacing, and it is very necessary to see that specified driving tolerances are adhered to when timber piles are driven prior to tie rod placing. Otherwise considerable difficulty in placing tie rods is likely to result. The original driving tolerances specified were not more than 3 in. out of place and not more than 3% out of plumb. Due to hard driving and obstructions it was found very difficult to drive to the tolerance and it was later relaxed with the owner's consent, and the timber piles were required to be driven not more than 6 in. off-centre transverse to the line of the dock and not more than 9 in. off-centre parallel to the dock provided, in the latter case, that the longitudinal distance between any consecutive pair of piles did not vary more than 12 inches from the theoretical centres.

As soon as it was practical, i.e., when truck access to the timber piles for the luffing crane was available, a test load was applied to a group of four piles already driven. A loading platform surmounted by a large sand box was constructed symmetrically on the four piles. The sand box was designed to hold 200 tons of sand to be placed in 50-ton increments. The sand was weighed on the construction weigh scale before being placed in the loading box. The average time taken for each 50-ton load increment was 2 hours. The load test was carried out in accordance with the procedure set out in the National Building Code, . Appendix 4.2.c.

The maximum and minimum settlements of the pile group were 1⅜ in. and ¾ in. respectively with full test load applied, and 1⅛ in. and ½ in. respectively residual settlement on removal of the test load. In the jetty construction the majority of piles were driven using the same construction method as used for the steel sheet piling, the remainder were partially driven by floating equipment and finished off by machine as dock construction brought time within reach. The total number of timber piles driven was 850.

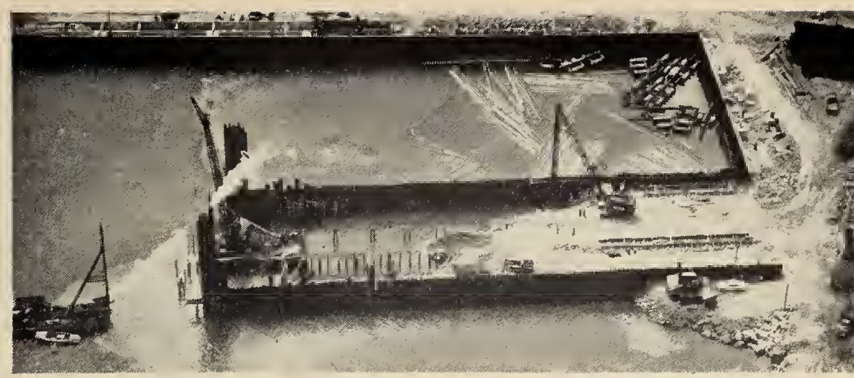


Fig. 11. Aerial view of jetty construction, June 1957.

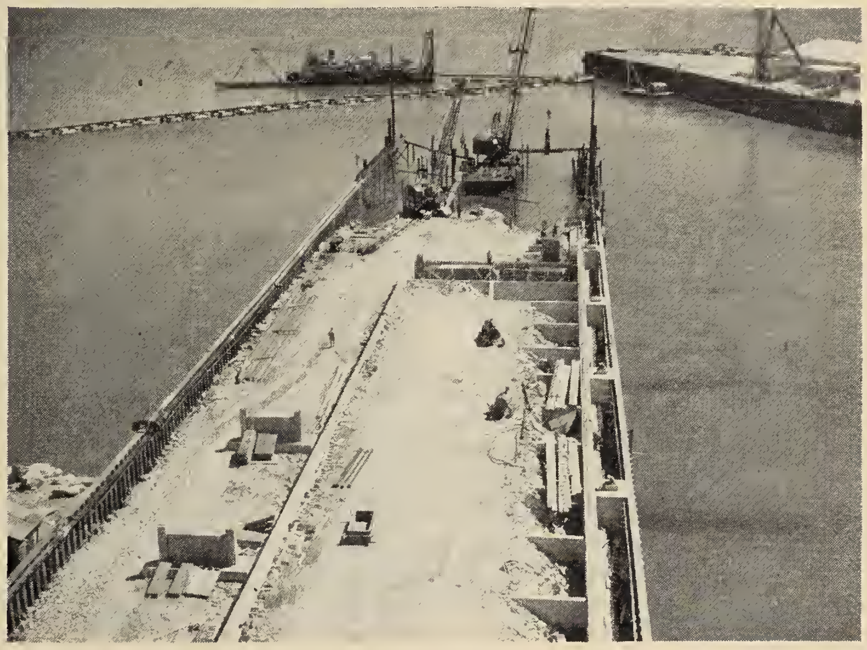


Fig. 12. Jetty construction showing unloading equipment foundations. Dredge working in background.

Construction of Jetty

A typical cross section of the jetty is shown in Fig. 10. Construction commenced at the west end and a truck-dumped rock-fill causeway up to tie rod level was constructed progressively. Timber piles which would be within this causeway were driven ahead of the causeway. A series of cribs were constructed of 12 in. x 12 in. timbers, and these were placed end to end on the causeway. Rock fill was placed up to the level of the rearmost crib which enabled the 1201 Lima machine to "walk" on to the cribs. Top of the cribs was elevation 14 ft. approximately. Sheet piles for the north and south walls were pitched and driven concurrently up to the limit of reach of the crane, and wales and tie rods placed. Thereafter the cribs were leap-frogged forward by the 1201 machine and rock-filled once more to extend outwards to the rearmost crib, (Fig. 11 and 12).

Rock fill behind the cribs was brought up to the level of the underside of the unloader foundations, the unloader foundations concreted, services installed and thereafter the dock area brought up to grade and surfaced initially with crushed gravel.

Construction Schedule

Throughout the construction of the wharf it was very fortunate that no major storms occurred and no part of the dock suffered damage. It is of general interest to note that during construction work on the existing Baie Comeau wharf in 1953, sudden and severe storms coincident with a critical phase of the construction resulted in damage in excess of one million dollars. As mentioned earlier, the most critical section of the C.B.A. dock was the bullnose of the breakwater where of necessity appreciable lengths of piling had to be driven and left free standing for fairly long periods before the piling could be tied back and fill material placed inshore from the piling. The danger of fall storms gave considerable anxiety and the work was pushed as rapidly as possible, including night shift work, with the aim of securing the bullnose section before September 1956. The completion dates called for in the contract proved to be realistic and the piling for berths 1 and 2 was completed in the late fall of 1956 within three days of the scheduled completion date. The first ocean vessel unloaded at berth No. 1 on 29 May 1957.

No dock construction was carried out during the winter but work resumed in the spring and the entire dock contract was completed on 20 September 1957. The first shipment of material was unloaded by the suction unloader at berth No. 3 on 3 October 1957.

The number of men employed on the contract reached a peak of 117 during the summer of 1957.

All concrete was supplied from the ready mix plant established adjoining the smelter site.

In order that the pneumatic unloader would be ready for unloading operations by September 1957 an erection area was provided inshore from the west end of the jetty leaving sufficient access space for the dock contractor. At the erection area, rails were laid on ties, the rails lining up with the permanent unloader rails on the jetty. By the time major erection of the unloader was complete, jetty construction was sufficiently advanced to enable the unloader to be towed on to the permanent rails on the jetty.

The second pneumatic unloader will be erected on the jetty during 1958. The completed dock (Fig. 13) is now in constant use during the shipping season and provides one of the finest harbours along the north shore of the St. Lawrence.

Fig. 13. Dock largely completed.

Fig. 14. Twenty-inch suction dredge and tug at anchor.

Dredging

The dredging was carried out under the supervision of the Department of Public Works. Dredging was carried out to 30 feet below low water using a 20 in. suction dredge (Fig. 14). Dredging commenced in October 1956 and all material dredged during the first year was pumped to partially fill the extreme west end of the bay.

The dredge wintered at the dock site and when dredging re-commenced in the spring of 1957 dock construction was sufficiently advanced to enable the dredged material to be utilized to reclaim the area between the dock and the shore line. This work progressed from east to west, the progress of filling being controlled by strategically placed dykes. The dredged material provided an excellent reclamation.

As mentioned earlier, in certain areas a very dense layer of sandy silt overlying the final dredged depth could not be removed by the suction dredge and this material was dredged by a Department of Public Works dipper dredge (Fig. 15).

As anticipated a substantial number of large boulders were encountered during the dredging. No particular difficulty was experienced in sinking these below the final dredged depth.

Final dredged quantities will be approximately 520,000 cubic yards.

Miscellaneous

Bollards are provided at approximately 75 ft. centre on each berth.

Each bollard is tied back by tie rods to precast anchor walls (or to foundation beams where these are conveniently located) to minimize load transfer to the sheet piling.

Weep holes 3 inches in diameter were provided in the sheet piling at elevation minus 1 ft. 0 in. every 9th pile.

Two ladders were provided on each berth, and one ladder centrally at the west end of the slip and east end of the jetty.

Fenders comprise a double row of used Euclid or similar tires suspended from the coping plate by galvanized wire cable. The spacing of the lower row of tire fenders is three times that of the upper row. At the close of the navigation season these fenders are lifted on to the dock.

Fig. 15. D.P.W. dipper dredge at work.

Ancillary Buildings and Services

A prefabricated transit shed, 60 ft. span 100 ft. long, is located inshore from the 120-ton derrick on berth 1. The harbour masters office makes an extension to this building at its north-west corner. A metal storage gantry, 75 ft. span by 200 ft. long, to carry a 6-ton overhead crane is provided inshore from berth 2. This gantry is designed so that it can be converted into a closed storage later by the addition of roof trusses, purlins, and girts. It is also designed for the addition of a second 75 ft. span bay and can also be extended either east or west or both.

The floor area of the gantry area which is subject to heavy loading comprises a 7 in. slab thickened to 12 in. at expansion joints. Joints are placed at close centres as some differential settlement is anticipated due to the comparatively short time that the fill material has been placed.

Reclaimed dredge fill was not used under this building. Quarry run rock was used up to the underside of the foundations and well compacted gravel fill from this level to grade level. A concrete apron extends from the north column line of this gantry to the face of dock. The luffing crane rails are set flush with top of the concrete, and timber filler pieces are provided on each side of each rail. In the event of substantial differential settlement of the rail tracks, which it is hoped will not occur but might do so, removal of these filler pieces would enable the rails to be packed level. Ample thread projection of the bolts securing the rails to the concrete foundations was provided to permit this to be done. Service water for the dock is brought from the main plant supply after chlorination by a 6 in. wood stave pipe to the west end of the bay where it connects to a 6 in. buried cast iron pipe. Line pressure at the dock is 175 p.s.i., which is adequate for fire protection as well as serving the general dock and ships requirements. Provision is made for draining the line for the winter period when the dock is not operated. Dock office sewage is fed to a septic tank which in turn discharges its overflow into the dock.

A 1,470,000-gallon oil company storage tank located inshore from berth No. 1 is connected to this berth by 10 in. oil line. From this oil tank a 4 in. oil line traverses the dock area and rises to the smelter plant itself enabling oil to be pumped direct from the marine tank to day storage tanks located in the smelter plant.

Electrical

A 1500 kwa. outdoor type substation is located at the west end of the dock and supplies all power and lighting requirements. All feed cables are buried. The substation is fed by the 13.2 kv ring main from the smelter plant the ring main cables being located within the conveyor gallery. All dock equipment operates on 550 volts, 60 cycle.

Dock lighting, which is of a high standard, is supplied by four 80 ft. floodlighting poles supplemented by additional floodlights on the dock equipment.

APPENDIX

Pile driving performance during 35-day period under hard driving conditions

	DAY SHIFT	%	NIGHT SHIFT	%
Number of shifts	35		32	
Total hours	346	100%	371	100%
Pitching of piles (hours)	139	40%	19	5%
Driving piles (hours)	98	28%	168	45%
Lost time (hours)	109	32%	184	50%

Breakdown of Lost Time

	DAY SHIFT	%	NIGHT SHIFT	%
Weather conditions	33	30%	26	14%
Steam supply breakdown	18	16.5%	28	15%
Hammer breakdown	10	9.5%	27	14.5%
Awaiting piles to be pitched	15	14%	3	1.5%
Flood lighting failure			4	2%
Sundry	33	30%	96	52%

When two shifts were worked very little pitching was done by the night shift but the number of piles driven at night was 70% greater than were driven during the day shift.

Rate of Pitching and Driving

During the above period during a typical week working two shifts for pitching and driving, the minimum and maximum rate of piles completely driven were 3 and 17 respectively per shift, the average per shift being 9 piles.

Acknowledgments

Consulting engineering for the dock — C. D. Howe Company Limited: D. H. Sharp, M.E.I.C., project engineer.

Construction supervision — Canadian British Aluminium Company Limited: Charles Miller, M.E.I.C., construction project manager.

Inspection services — Racey MacCallum & Associates.

Aerial photographs are by George Hunter.

The Manicouagan Power Development

J. M. Higgins,

Manager of Construction, Quebec North Shore Paper Company, Thorold, Ont.

C. Miller, M.E.I.C.

Construction Project Manager, Canadian British Aluminium Company Limited, Baie Comeau, Que.

Read at the 72nd Annual General and Professional Meeting of the Engineering Institute of Canada, Quebec City, May 1958

THE MANICOUAGAN Power Company constructed its first stage of development in 1951-52 with the initial two units of 100,000 h.p. Associated with the building of the Canadian British Aluminium Company Limited the powerhouse was further expanded to a total of 250,000 h.p. during 1956-57.

This paper describes the first and second stages of construction. One of the outstanding features of the initial construction was the unwatering of the main damsite without the aid of cofferdam, probably for the first time in history that water has been diverted to leave the bottom almost bare for the foundations of a large dam. The second section of the paper describes the construction of the stage II development.

Initial Development

The initial development consisted of constructing a dam, spillways, powerhouse and associated switching station and transmission line for two units generating a total of 100,000 h.p. The work was started in March 1951 and the first generator was energized on the line in December 1952.

Flow Characteristics of the Manicouagan River

The Manicouagan River is the third largest tribuary of the St. Lawrence River, only surpassed by the Ottawa and Saguenay Rivers. It flows into the St. Lawrence River near its mouth, approximately 250 miles below Quebec City.

Figure 1 shows the location of the Manicouagan River, which drains from 19,000 square miles of the Quebec interior into the St. Lawrence River.

The flow is characteristic of the rivers in the northern part of Canada. During the winter the flow is low, but is followed by a tremendous increase during the spring flood period, amounting quite often, to 50 times the low winter flow (Fig. 2).

A typical hydrograph of the Manicouagan River (for 1947) is shown by Fig. 3. It will be noted that the winter flow is down to 6,000 c.f.s. However, when spring comes, and the accumulated snow-fall begins to melt, this results in a high spring flood which, in 1937, went up to 213,000 c.f.s. which is the normal flow of Niagara Falls. After the spring flood, the summer and fall floods are between 25,000 and 50,000 c.f.s.

Description of Power Development

The Quebec North Shore Paper Company plant at Baie Comeau was built in 1937. At that time, the powerhouse was built at Outardes. However, with the increased production at the mill, additional power was necessary in order to supply a reserve and safeguard the paper company's operations. Also, the company has large timber limits on the Manicouagan River and it was necessary to build a dam to provide a safe holding ground for the pulpwood.

The power expansion scheme on the Manicouagan was studied by the company's engineers since 1946, with H. G. Acres & Company as consultants. A decision was made in May, 1950, to proceed with the power development. After studying approximately 26 layouts, the final scheme selected is shown by Fig. 4. The damsite is approximately 4,630 feet long and, at its highest point where it blocks the main channel, it is 97 feet high. Water is supplied from the intake to the powerhouse by a rock tunnel and the tailrace discharges to the estuary of the Manicouagan River. The head will be approximately 125 feet.

The dam, named after Colonel Robert R. McCormick, owner and publisher of the *Chicago Tribune*, will create a lake about 11 miles long. Colonel McCormick, together with Arthur A. Schmon, president and general manager of the Ontario Paper Company and its subsidiaries, are responsible for initiating and planning the development. For many years, engineers thought it was too expensive to harness the Manicouagan River. Hence, paper companies sought limits on smaller, more manageable streams. Now the Manicouagan has been harnessed for pulpwood operations as well as for the development of power.

The greatest problem presented was to provide for a dry bed for the dam foundations. Unusual risks from flash floods and deep water would be incurred in constructions of cofferdams; the normal procedure. A new scheme of unwatering was developed from an hydraulic model study.

Model Studies

During the studies a decision was made in 1949 to build an hydraulic model, in a scale horizontally of 200 feet to the inch and vertically 50 feet to the inch. This model, some 30 x 60 feet, was built at Baie Comeau.

The contours of the First Falls were such that a great number of layouts of dams and powerhouses were presented. All of these were placed on the model and tried out for low flow and the extreme flood of 320,000 c.f.s. Fig. 5 shows a view of the model. Accurate contours of the Manicouagan River bed and valley were moulded in sand to the proper scale and covered with concrete. This model proved of great value in the design of the dams and powerhouse.

Building of a dam across a large

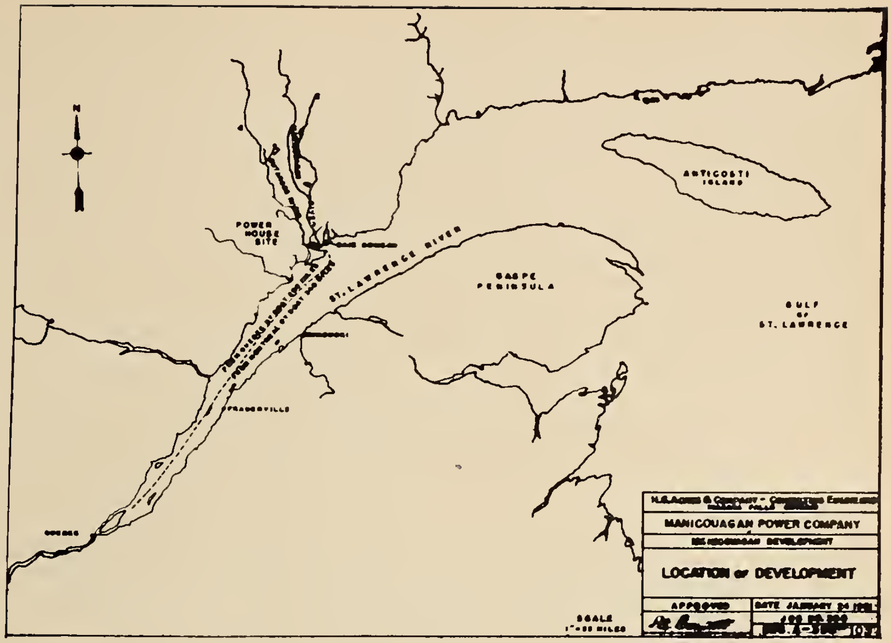
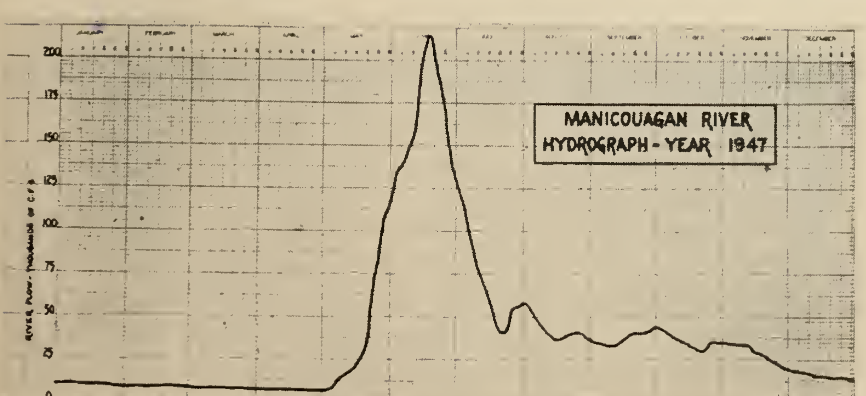


Fig. 1 (above). Location of the Manicouagan River.

Fig. 2. Flow of the Manicouagan River during the spring flood period.

Fig. 3 (bottom). Hydrograph of the Manicouagan River for the year 1947.



river is a difficult construction job. The first plan was to build the dam in the conventional way, in two stages; that is, a cofferdam on one side of the river to build the foundations. This, of course, would have to be carried out during the low flow stage of the river, in the wintertime. Following this, the water would be diverted through the completed section and the opposite side would be cofferdammed and the remaining part of the dam completed. Due to great depths of the river, the cofferdamming would require most of the low flow periods.

In the course of the studies to build the dam three different schemes were investigated:

(a) Cofferdams.

(b) Diversion channel and cofferdams on north side of Schmon Rock.

(c) Dropping 15,000 ton obelisk.

All of these schemes would have required a 2½-year construction program and involved large hazards of high cofferdams and swift water.

While carrying out the model studies, it was also decided to carry out a study on the model of diversion. In the progress of this work, a unique scheme presented itself. If an unwatering tunnel or channel could be built from a deep pool upstream to the estuary, it would drain out the pool above the upstream of the damsite and make bare the dam foundations.

The next problem was the design of the tunnel. Fig. 6 shows the average weekly river flow from October to May. It was decided that if an unwatering tunnel or channel of a capacity of 20,000 c.f.s. was selected, it would give approximately 4½ months to close the main dam.

It was necessary to make accurate soundings of the river bottom. This was very difficult on account of the rapids at the First Falls. Some soundings were obtained through the ice and additional soundings were taken with echo sounders.

Relative to the design of the unwatering tunnel, three schemes were studied:

(a) Rock-cut.
(b) Tunnel.
(c) Combination rock-cut and tunnel.

The lay-out is shown by Fig. 7. The tunnel was excavated by a ramp at the south-end, the rock was taken out, leaving the upstream and downstream plugs. A shaft was made for the closure gates. It will be noted that the floor of the upper end of the tunnel is 70 feet below the water level in the river. This was necessary in order to drop the elevation of the pool to make bare the dam foundations. The upper and lower plugs would then be blasted to divert the river through the unwatering tunnel.

In the fall of 1951 an additional hydraulic model was built by H. G. Acres & Company to study the best design of inlet for the unwatering tunnel. This model was of considerably smaller size than the previous one and built to a larger scale (in this case a true model scale of 1 to 72). The purpose was to develop an intake which would provide no throttling action on the capacity of the tunnel, would be economical and feasible from a construction standpoint, and would provide a sump for the retention of large rock, resulting from the blasting of the plug. It was calculated that all rock smaller than 2 cu. yd. in volume would be swept through the tunnel by the high velocity.

A large number of tests were run on this model and the final design of the intake was based to a large extent on the test results.

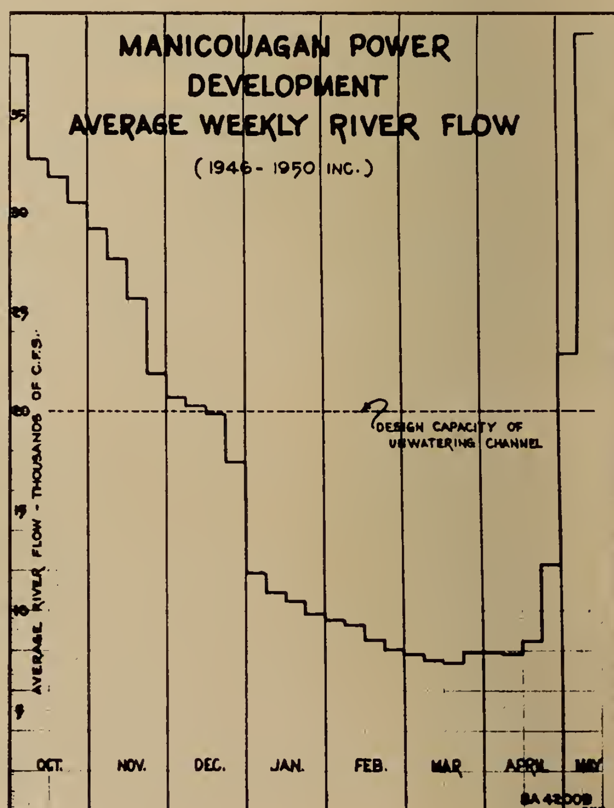
Unwatering Tunnel Construction

The construction of the unwatering tunnel started in April, 1951, and was completed eight months later on

Fig. 4 (above). Manicouagan Power Company—First Falls development.

Fig. 5 (below). Hydraulic model of the project.

Fig. 6 (right). Average weekly river flow (1946-1950 inc.).



December 1st, 1951. The tunnel was ramped down from the south end to grade. Also, a sump was made to receive broken debris from the plug. The diameter of the tunnel was the equivalent of 35 feet as, actually constructed, it was a horse-shoe shape with a flat bottom.

The face was drilled off with a jumbo with approximately 12 ft. steel. This gave an average of 10.5 ft. advance. The average advance was approximately 9 ft. per day.

Fig. 8 shows the tunnel shovel excavating the muck. A standard 1½ yard shovel was used with a short shovel boom. The muck was hauled out with heavy 16-yd. diesel trucks (Fig. 9).

Blasting of the Tunnel Plugs

The blasting of the tunnel plugs was a hazardous operation. Fig. 10 shows the lower plug before blasting. The rock was excavated as close as possible to the river.

The coyotes underneath the river had to be carefully drilled, and an exploratory hole was drilled ahead to make sure that water would not be encountered. Fig. 11 shows this work in progress.

After their completion, the coyote tunnels were loaded with dynamite (Fig. 12). The upper plug contained 7,027 cu. yd. of rock; it was loaded with 36,000 bl. of dynamite or an average of 5.1 lb. per yd. The lower plug contained 2,027 cu. yd. of rock; it was loaded with 8,188 lb. of dynamite or an average of 4 lb. per yd.

Before blasting, very elaborate plans had to be made at the site, in order to have all machinery and people cleared. A system of roadblocks was set up and notices posted. No one was allowed within 2,000 feet of the blast.

On December 3rd, 1951, the lower plug was blasted at 11:00 a.m. (Fig. 13). The highway bridge was covered with drier felt to protect the steel members. An examination showed the blast had cleared all the rock down-grade.

The upper plug was blasted 35 minutes later (Fig. 14). As previously stated, this blast contained 36,000 lb. of dynamite which hurled rock and water 200 feet into the air and splintered 7,000 cu. yd. of granite rock into fragments, leaving a trench that lead to the tunnel entrance. Seconds later, the river was roaring through the tunnel and one hour later the river channel was almost dry. Fig. 15 shows the river rushing through the tunnel, 5 minutes after

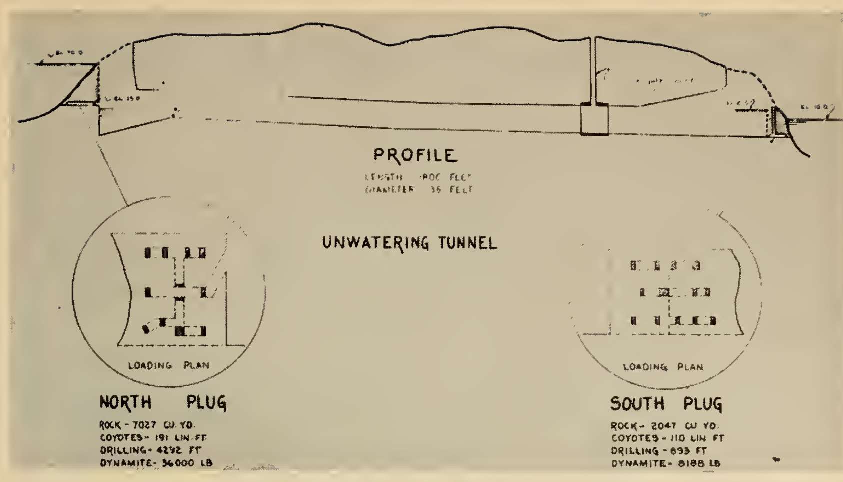


Fig. 7. Lay-out of the design of the unwatering tunnel.

Fig. 8. McCormick Dam. View of tunnel shovel loading truck in unwatering tunnel. June 18, 1951.

Fig. 9. McCormick Dam. View of trucks in unwatering tunnel. June 18, 1951.

the blast. Hence, this blast was unusual, not only as a spectacle in a river diversion, but, probably for the first time in history, this diversion lowered the water level at the damsite some 30 feet to leave the river bottom almost bare for the foundations of the large McCormick Dam.

Fig. 16 shows a comparison after and before the shooting of the plug. It will be noted that after shooting not only was the level diverted, but the water level exposed the dam foundations and allowed the contractor to proceed immediately. Hence, the main dam was completed without the aid of coffer dams.

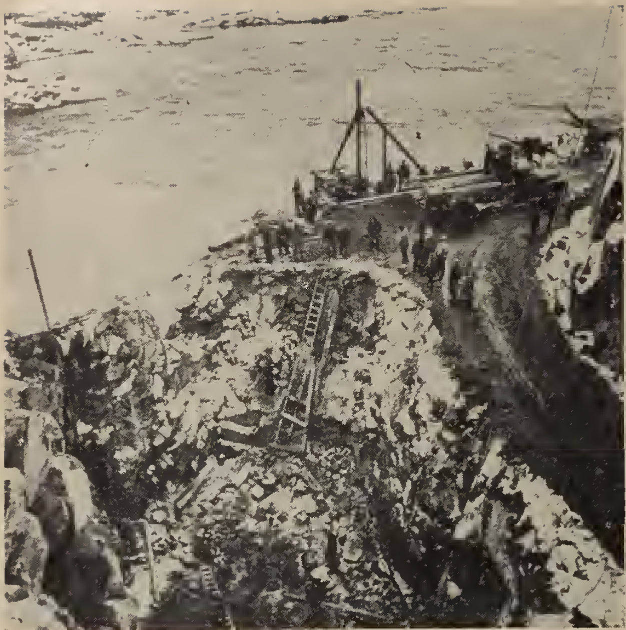


Fig. 10. McCormick Dam. Downstream plug as seen from above lower tunnel portal. December 1, 1951.

CONCLUSIONS

In conclusion, the objective to divert the Manicouagan River and complete the main dam was realized. This diversion has resulted in:—

(1) Cost of the diversion tunnel was less than the conventional cofferdam system.

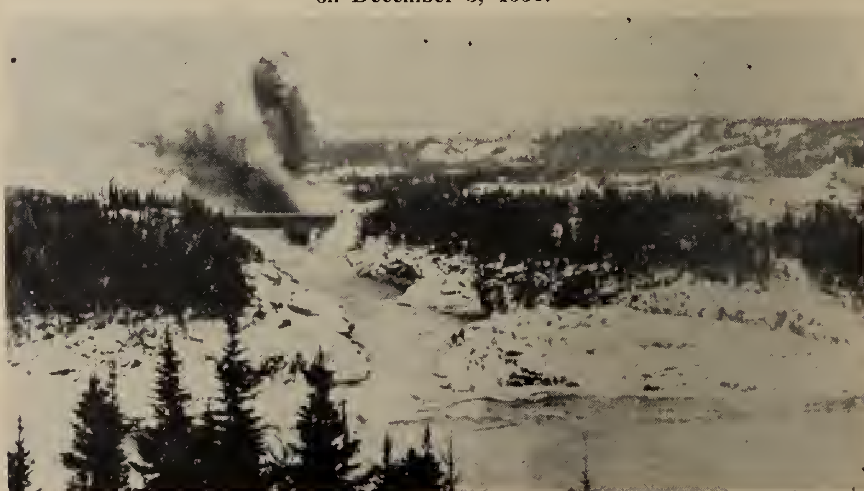
(2) The diversion tunnel scheme was less hazardous than building cofferdams in fast water.

Fig. 11. McCormick Dam. Ring drilling the coyote tunnels, underneath the river. October 31, 1951.

Fig. 14. McCormick Dam. Blast of the north plug of unwatering tunnel at 11.35 a.m. December 3, 1951.

Fig. 12 (left). McCormick Dam. Loading south plug coyotes of underwatering tunnel with explosive.

Fig. 13. McCormick Dam. Blasting the south plug of unwatering tunnel at 11 a.m. on December 3, 1951.



(3) We were able to cut at least 10 months off the 2½ yr. construction schedule. Hence, the power will be available 10 months in advance of the conventional methods.

McCormick Dam Project No. 2

Late in 1955 a decision was taken to extend the Manicouagan Power Company's McCormick dam plant at Baie Comeau, Quebec, by adding three additional units.

H. G. Acres and Company, consulting engineers, were asked to proceed to develop plans and specifications, and immediate steps were taken to safeguard the position with the manufacturers for the supply of generators and turbines.

Specifications were developed for the new units and "on power" dates for the three units were set as follows: Unit No. 3 - December 1, 1957; Unit No. 4 - February 1, 1958; Unit No. 5 - April 1, 1958.

The completion dates for the three new units at McCormick Dam were established to suit the requirements of the Canadian British Aluminium Company, in order that they could complete their stage one on schedule.

In order to provide a firm block of power, it was necessary to provide storage on the Manicouagan River, and it was decided that this could best be done at Lake Ste. Anne on the Toulnoustook River, a tributary of the Manicouagan. Quebec Hydro undertook to provide this storage and plans were then put in motion to have a storage dam completed at Lake Ste. Anne in time to store at least twenty billion cubic feet of water by the fall of 1957. The total storage capacity of the dam is 126 billion cubic feet and full run-off of the watershed above this dam was to be stored during the spring run-off of 1958 and be available for the winter of 1958-59.

The main purpose of this paper is, therefore, to describe briefly the major steps taken in the construction of the extension known as the McCormick Dam Project No. 2 and to touch briefly on the development of storage at Lake Ste. Anne.

Statistical and Design Data

During the first stage of construction in 1951-52 the main dam and spillway gate sections were constructed, and in addition, a powerhouse to accommodate two units. These generators were rated at 37,-

Fig. 15. McCormick Dam. Manicouagan River flowing through unwatering tunnel, at 11.40 a.m. View of the south portal. December 3, 1951.

Fig. 16. A comparison after and before the shooting of the plug.

Fig. 17. Erecting structural steel in power house.

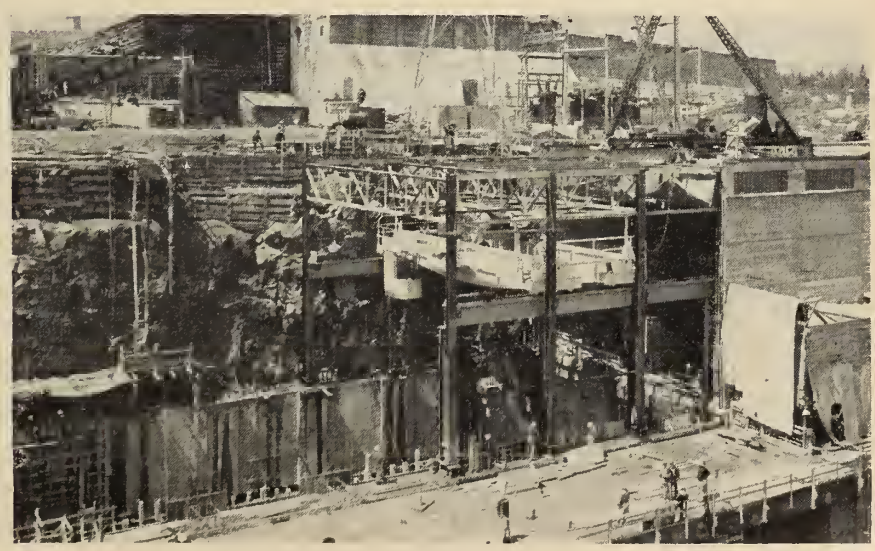


Fig. 18. Tailrace excavation.

500 kva., and it was decided to install 50,000 kva generators for the new development. The turbine rating for the original two units was 56,000 h.p. and the turbine rating for the new units was set at 60,000 h.p.

The headworks was constructed for only two units during the first stage, and a temporary rock-filled timber crib cofferdam, together with a rock-filled gravity section, were left in place for the future construction of the balance of the headworks. This was designed to take a further five units, and it was constructed so as to allow for the building of the new section of the headworks completely in the dry.

It was decided to design the extension to the power house to accommodate only the three units to be installed during stage two, but to carry the excavation of the power house for a further single unit in order to ease the rock excavation problem when it came time to add the final two units.

It was also decided to complete the headworks for the balance of five units rather than put in any temporary timber cribs or rock-filled dams, and therefore stage two includes headworks for five additional units.

The tailrace for the three new units was designed to take the flow (approximately 15,000 c.f.s.) from the three units, and to do this required a rock cut 60 feet in width from the power house to tide water.

Transmission of the power from the new units to the Canadian British Aluminium plant at Baie Comeau was designed as a 161,000-volt line. In order to transmit at this higher

Fig. 21 (below). Bailey bridging across tailrace No. 1.

Fig. 19. Pouring concrete in headblock No. 7.

Fig. 20. Powerhouse excavation and portals to all tunnels.

voltage it was therefore necessary to build a new switching station and to put in step-up transformers to step up from the stage one transmission of 69,000 volts.

The construction schedule followed very closely the pattern of the first stage of construction carried out five years previously; this called for rock excavation to start in the spring of 1956 with the first unit to be "on power" by December 1st, 1957. The time allowed, therefore, from the inception of the work by the general contractor to the time the first unit produced power, was a matter of only eighteen months.

General Construction

The general construction can be divided into four main sections: the rock excavation; the headworks concrete; the power house concrete; and finally the 161 kv transmission line.

The calls for tenders for the general contract work was made in the winter of 1956, and the general contract awarded. Rock excavation was started in April 1956 and substantially completed during the year, and a start was made on the concrete work.

From experience during the first stage of construction, it was realized that to meet the "on power" schedule it would be necessary to carry out winter concreting, and the operations were designed to pour concrete during the first winter.

The tailrace excavation, which comprised the major part of the rock excavation, included the leaving of a rock plug at the downstream end until the second year in order that the powerhouse could be constructed in the dry.

The rock excavation in the powerhouse area, as well as part of the tailrace area, had to be carefully carried out due to the close proximity of the existing powerhouse, switching station, etc. Seismographs were set up in the powerhouse area, and throughout the rock excavation in this area the amplitude of vibration was kept within an allowable figure of twenty-thousandths. Throughout the blasting this figure was never reached, and for the most part the vibrations were not more than 50% of the figure allowed.

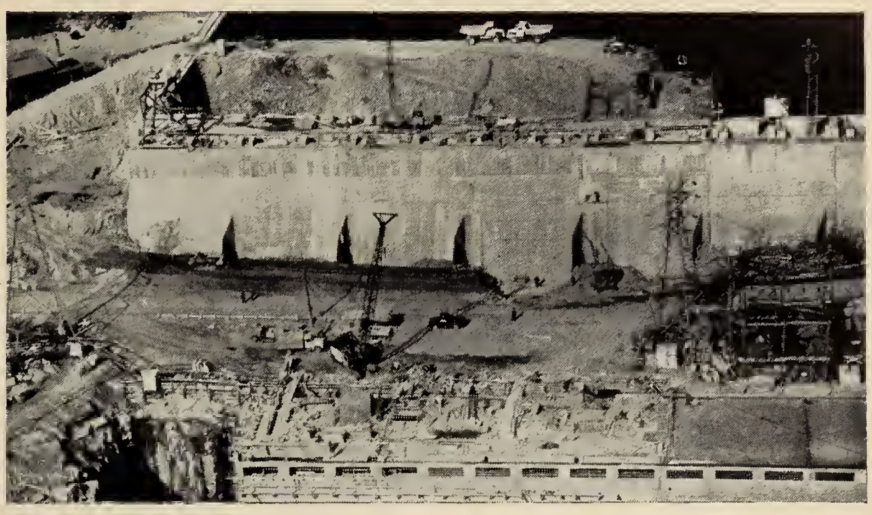


Fig. 22 (top). Powerhouse excavation with rock filled timber crib in the background.

Fig. 23. Headworks and start of timber crib removal.

Fig. 24 (below). Drilling tailrace plug after toe blast.

Stage two construction, being an extension to the present power house, also involved two other unusual features, the first of which was the construction of a bridge across tailrace number one to carry the extension to the 69 kv switching station. This involved a number of difficult operations as it was closely confined on one side by the new tailrace excavation and on the other side by the existing switching station. Also, it was necessary to design for heavy loads in order to take care of the circuit breakers, and erection over the tail-

Fig. 25. Tailrace plug blast.

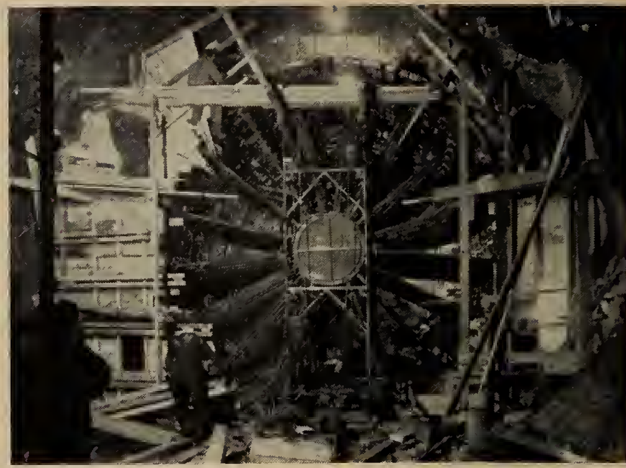


Fig. 26. Circular travelling form in conduit No. 3.

race presented a difficult forming problem. After considerable investigation and consultation, it was decided to use Bailey bridging for falsework and construct a reinforced concrete beam and deck bridge. This worked out very well and the use of the Bailey bridging made it possible to complete the erection of the bridge almost on schedule.

Another difficult problem was the removal of the timber crib which was placed during the first stage of construction as the connection piece between the section of the headworks then built and the rock-filled dam connecting across the future headworks intake area. The removal of the timber crib was studied very carefully by the general contractor and the consulting engineers, and the schedule for the removal was very tight as it had to be out in sufficient time to allow water into the passages of No. 3 unit by 1st December, 1957, and at the same time it could not be removed until all of the headworks construction had been completed.

After discussing various schemes, the contractor decided that it could best be done by using a back hoe and working from the top of the crib, taking it down in stages and in various sections, with the last of the material to be clammed out under water. This program was instituted and the pull shovel method worked remarkably well. The crib was taken out on schedule and the cleanup of the bottom by clam was all that could be desired.

The tailrace plug was a difficult problem due to the fact that rock shelved off gradually into the main river channel and this necessitated considerable amount of drilling and blasting of the toe section under water.

The general contractor originally planned on using the coyote method of excavating the rock plug left in the end of the tailrace, but due to shattering of the rock possibly from the first stage of construction, also due to fissures in the rock, a water problem indicated that the coyote method would be very difficult. It was then decided to go to vertical drilling only and to remove the plug in two stages. The first stage, that is, the underwater section downstream from the plug, worked very well but unfortunately the main plug of rock was badly shattered, with the result that the tailrace was flooded. It was, therefore, necessary to re-drill a great deal of the major part of the plug, and these drill holes were carried down to five feet below the finished grade. A drilling pattern of 6 by 6 was laid out and the total of 96 holes was drilled with an average depth of 40 feet. Millisecond caps with nine delays were used and a powder factor of 3.27 pounds per cubic yard was the actual loading. The results obtained from this plug blast, at the time of the blast, appeared good. However, it was later found that a great deal of the muck, although broken, was not broken up as well as expected and most of it stayed in position. This resulted in a long clamming operation which although successfully completed, was expensive and it took a long time finally to clear the channel.

As mentioned earlier, concreting was carried out throughout the winter of 1956-57 and a very close system of concrete control was put into effect for the whole job. Aggregates obtained from crushing the rock taken from the tailrace and the power house excavations were used, together with the sand for fine aggregate found in the vicinity of the project. This sand was so fine that blending was not required and a very good concrete mix was obtained by using two sizes of coarse aggregate together with the local sand.

Throughout the job the general contractor employed panel forms consisting of plywood sheet on lightweight steel frames, and these were light enough for one man to handle and worked out very well. An unusual type of travelling metal form was used for pouring the horizontal sections of the three water conduits. This form, of English design, worked very satisfactorily, with one form used for all three tunnels.

Transportation of heavy lifts was again a problem, because limits on highway bridges made it impossible to carry the runners, the upper bearing brackets, and the auto-transformers from the wharf at Baie Comeau to the job site. It was, therefore, necessary to charter a shallow-draught motor ship—an L.S.T. of 147 gross tons, which could safely navigate the Manicouagan estuary at high tide. Eight trips were required to carry the three 50-ton runners, the three 40-ton upper bearing brackets, and the two 90-ton auto-transformers. This operation involved unloading at either the Baie Comeau Government wharf or the C.B.A. wharf on to a low-bed trailer already positioned on the barge and transporting the whole load, including the tractor, out into the St. Lawrence and thence up the Manicouagan estuary to one of two landing stages on either side of the

Manicouagan River. The tides and the river flow made this operation rather difficult, and a great deal of time and study were required to carry it out successfully.

Lake Ste. Anne Storage

As mentioned earlier, Quebec Hydro undertook the construction of the Lake Ste. Anne reservoir on the Toulnoustook River to provide sufficient storage to operate the new Manicouagan Power Company units. This storage will hold approximately 126 billion cu. ft., which comprises approximately 18% of the Manicouagan watershed, or an area of 3,160 square miles.

The construction of the reservoir and the storage dam comprises a control section with three upper and three lower gates, with a total discharge capacity of 102,000 c.f.s. The main dam is a rock-filled gravity structure having a total height of 124 feet. The construction of this dam was started in 1956 and the gates were finally closed in late '57. Although it was only expected that 20 b.c.f. would be stored the first year, the storage actually amounted to over 31 b.c.f. before it was started to draw down late in March.

Electrical Installations

The electrical installations include the provision of an entirely new switching station for the 161 kv transmission and the construction of a ten-mile transmission line to Baie Comeau. The present 69 kv switching station was also extended to take in the first step-up in voltage from the generator voltage of 13,800. It was also necessary completely to change the control room and the control board and bench board to accommodate the three new units, and at the same time make provision for the final two generators which may be installed at some future date.

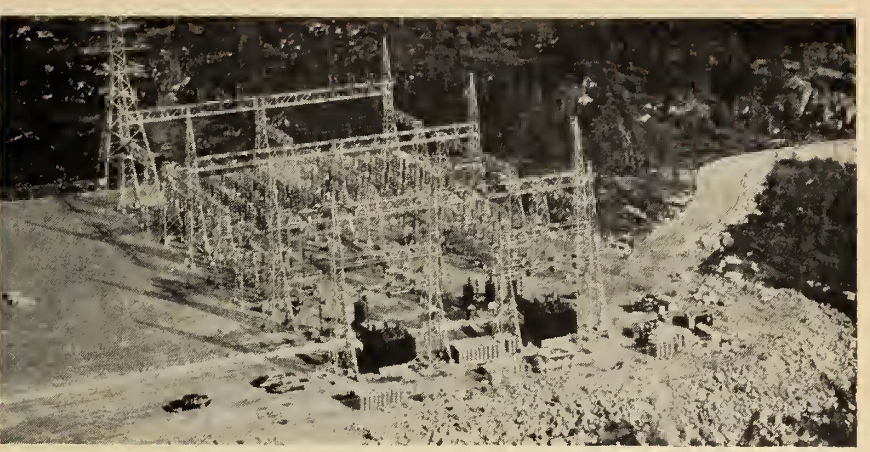


Fig. 27. 161 kv switchyard with 125,000kva auto-transformers in foreground.

Two separate contracts were awarded to carry out this work, one for the transmission line, and the electrical contract, which included all the switching station work as well as the power house and station service installations. It was necessary to supply C.B.A. with a limited amount of power from the present two units, by October, 1957, and the transmission line contract was completed, on schedule, and power transmitted to C.B.A. late in October, 1957. The generators were purchased on an installed basis and these were installed, on schedule, by the suppliers.

CONCLUSIONS

Despite a general strike in the winter of 1957 which caused a five-week delay, the general contractor completed his work on schedule, getting the first generator on the line on December 3rd, 1957. This "on-power" was about two days behind the original schedule, but the five weeks' delay earlier in the year did not materially affect the final on-power date. The other two units, although a few days late in each case, were on the line within reasonable time of scheduled dates and sufficient power was available for the C.B.A. plant as the aluminum pots were brought on the line.

The turbines were installed by the suppliers on time, and although some difficulties were experienced during the installations, necessitating the dismantling of two of the units, these were overcome and the units brought on the line according to schedule.

In concluding, it should be pointed out that not only were the three units brought on power on time, but also the cost has been maintained within the budget allowed.

Fig. 28. Winter view of completed project.

Acknowledgments

It was only possible to carry out this construction with the help and assistance of our own management together with our consulting engineers and our contractors. The following personnel played a big part in assisting those who were entrusted with the actual field work.

Manicouagan Power Company
Arthur A. Schmon, president and general manager; J. E. Vallillee, executive vice-president; M. H. Jones, M.E.I.C., vice president and chief engineer; W. L. Eliason, chief electrical engineer.

Stage I. Charles Miller, M.E.I.C., chief hydraulic engineer and manager of construction; J. P. Sterling, M.E.I.C., resident engineer; V. M. Wallingford, M.E.I.C., asst. resident engineer.

Stage II. J. M. Higgins, manager of construction; G. M. Mikkelborg, resident engineer; A. H. C. Carson, senior field engineer; D. G. Kitson, superintendent of power houses.

Consulting Engineers, Stages I and II, H. G. Acres & Company, Niagara Falls, Ont.

The Modernization of Imperial Oil Refinery at Halifax

C. M. Stewart, JR.E.I.C. *Imperial Oil Limited, Sarnia, Ont.*

On October 11, 1956, the completely modernized 42,000 barrel per day Halifax refinery of Imperial Oil Limited was officially opened by the Honourable Henry D. Hicks, Premier of Nova Scotia. Since that date, additional units have been added to this construction program. This article indicates some of the reasons behind rebuilding the refinery and some of the design and construction problems encountered in the execution of this project. The total expenditure on this modernization program amounted to approximately $30,000,000.

This Halifax refinery has been of considerable importance in the economic life of the Maritimes since it was initially established early in 1918. It served as an important supplier of petroleum products during two world wars and through the intervening and subsequent peace time expansion. It was the base for the 'shuttle service' during this past war, where neutral American tankers hauled oil into a number of tanks belonging to the British Petroleum Board; the products were then taken overseas by allied ships. The refinery also fuelled the multitude of convoys and their protective warships that gathered in Halifax Harbour before leaving for overseas.

Following World War II the quality of petroleum products required by new automobile designs increased very rapidly. No sizable additions or modifications were made to the refinery during this period and, as a result, the equipment became outmoded. This made it necessary either to close down the refinery and import all the required products from the Gulf area, using the facilities as a bulk plant, or to replace the existing plant with a much larger, completely modern manufacturing installation. Extensive economic studies were carried out and future Maritime requirements were assessed both with regard to quantity and quality. On the basis of these studies it was decided to modernize and expand Halifax refinery to bring it completely up to date.

Process Facilities

The new process facilities consist of seven main units which are shown in Fig. 1 and 2. The generalities of the flow of raw material and resultant products through the refinery are shown on Fig. 3. The refinery units were designed to operate on Venezuelan crude with Middle East crude as an alternative feed. All crude is brought to the refinery by tanker.

The first unit, a 45,000 b.p.s.d. atmospheric and vacuum unit, essentially splits the crude into gasoline constituents, fuel oil products, and fractions which are further processed in succeeding units.

The catalytic cracking unit breaks the heavier hydro-carbon into lighter, higher octane fractions in the presence of a catalyst which is continuously regenerated to maintain high activity. Gases, gasoline stocks, heating oil, and bunker flux are produced. The cat. cracker is a 15,000 b.p.s.d. Esso Research and Engineering Model IV design, which includes a preheat furnace to maintain unit heat balance.

In the refining of products in the atmospheric and vacuum unit, the cat. cracker, and the powerformer, a considerable amount of gases are produced which entrain high boiling point fractions with them. The light ends recovery unit recovers these potential gasoline stocks which would otherwise be lost to fuel gas. The light ends unit also produces the feed stock, for the 5,000 b.p.s.d. catalytic polymerization unit, which consists of butylenes and propylenes.

The 'cat. poly.' plant in general works in reverse to the cat-cracking unit. Where the cat. cracker breaks heavier fractions down, the cat. poly. plant builds light fractions into heavier hydrocarbons. Polymerization is carried out at elevated temperatures and pressures in the presence of a phosphoric acid catalyst to produce liquid polymer, a constituent of high octane gasoline.

An 800 b.p.s.d liquified petroleum gas plant further processes gases from the cat. poly. plant to produce propane. Also associated with this plant are storage facilities, loading compressors and a tank car rack.

The gasoline octane rating required

Fig. 1 (above). Overall view of the process area, Halifax modernization. Left to right: the A & V unit, model IV cat cracker, light ends recovery unit, catalytic polymerization plant, and L.P.G. unit and powerformer.

by automotive engines is now as high as was required by aeroplanes during this past war. To produce these high quality gasoline stocks a 7,000 b.p.s.d. Powerformer is utilized. This cyclic regeneration unit is charged with relatively low octane natural naphthas. In the presence of a platinum catalyst the molecular structure of the feed is reformed to produce high octane gasolines. This plant incorporates a feed pretreatment hydrofiner to desulphurize the hydrocarbon feed.

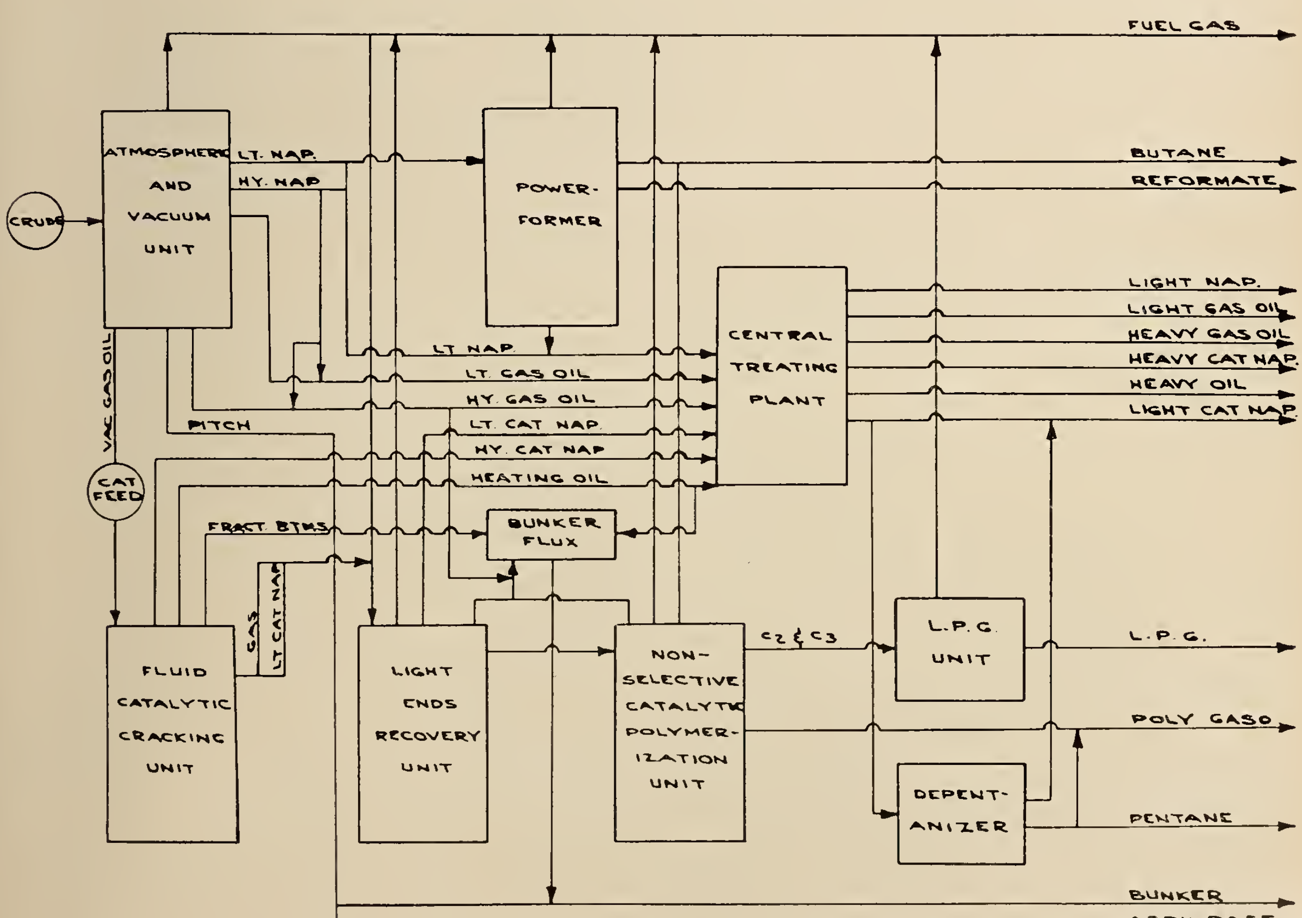
A central treating plant, made up of six treating systems, removes from the raw products constituents which are undesirable in the finished products. Inhibitors are also added at this plant to prevent product deterioration in storage. These plants are shown in Fig. 4.

The process equipment incorporates a number of recent design features. For example, electrical coalescers using a potential field of 45,000 volts d.c. are used in the treating plants to separate emulsions in heating oil streams. Float valve trays having variable capacity orifices were used in the lower section of the absorber demethanizer tower in the light ends unit.

Central control facilities serve the a. and v. unit, cat. cracker, light ends recovery unit, and the cat. poly. plant. Figure 5 shows a section of the graphic panel which uses miniature

Fig. 2. General view of A & V unit and cat cracker with cat poly plant in background.

Fig. 3 (below). Schematic flow diagram of Halifax refinery.



strip charts to outline the process operation. Similar facilities are provided at the Powerformer and a much less elaborate arrangement is included in the treating plant.

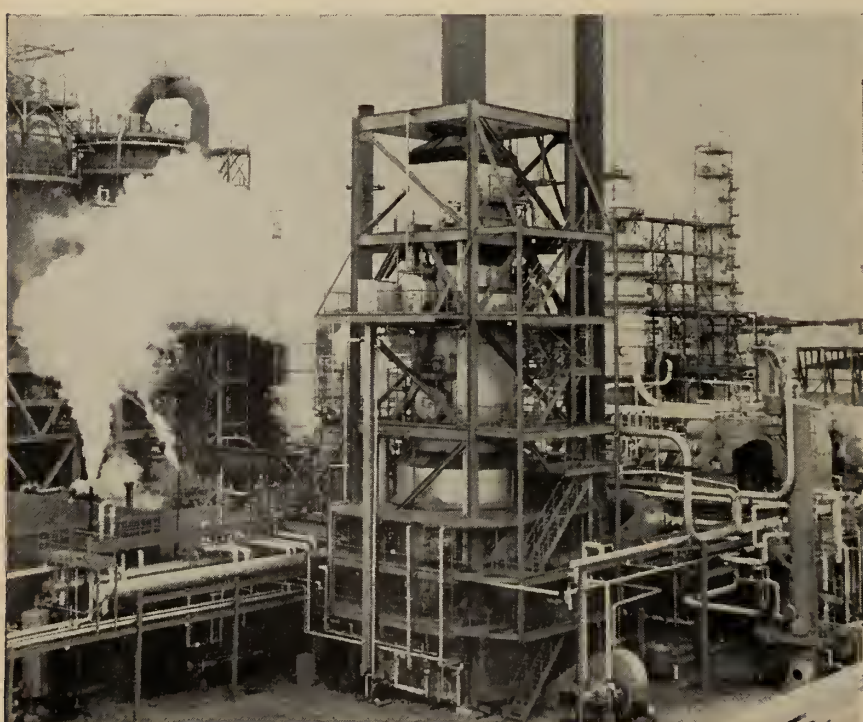
The process units have been designed for operation with minimum manpower. This type of operation makes rapid communications between process personnel on the units essential. To accomplish this, a communication system was installed at each major unit whereby operators in the control building could call personnel on the unit by loud speaker. They in turn could go to a talk-back station and establish telephonic contact directly with the control room. This feature will also greatly assist maintenance work on unit turn-arounds.

A new steam plant was included in the modernization. This plant consists of three 125,000-lb. per hour, 625 p.s.i.g. outdoor boilers. Two of these boilers are of conventional design while the third is a CO boiler. This boiler utilizes 1100°F. gases from the cat. cracker regenerator in addition to standard types of fuels. These gases contain carbon monoxide and other combustibles which result from the burning of coke, formed in the cat. cracking operation, from the catalyst. The CO boiler recovers the heat of combustion and sensible heat from these otherwise waste gases. This results in a substantial fuel saving. The regenerator gases can be diverted to atmosphere through a water seal arrangement permitting boiler firing entirely on auxiliary fuel. This boiler is shown in Fig. 6.

Fig. 4. Central treating plant.

Fig. 5. Section of graphic panel in combined control room.

Fig. 6. 125,000 lb. per hour 625 p.s.i.g. CO boiler with conventional boilers at extreme right and utility building at extreme left.



A utility building houses the control panel for all boilers and their auxiliaries, all pumps, internal chemical treatment facilities, and yard and instrument air compressors. A 3,000 U.S.g.p.m. fire pump which feeds a looped fire protection system is also included.

To supply electrical power to the new plant, Nova Scotia Light and Power Company ran five miles of 69 kv. line on wooden H-form transmission towers. This voltage is stepped down at the refinery to 23 kv. and tied into two other 23 kv. power sources to ensure as reliable a source of power as possible. The voltage is further stepped down to 13 kv. and distributed to the process unit substations at this level, through a ring system. This is the highest distribution voltage used in any of Imperial's refineries. From the substations, power is distributed to the various area users at 4160, 480 and 120 volt levels. In all, eight substations were required for the new distribution system. The ultimate power demand of the refinery is equivalent to a domestic community of 20,000 people.

The layout of new equipment was made with a view to facilitating maintenance. In general, equipment such as pumps, exchangers, furnaces and towers are grouped, with ample clear space left adjacent to these items to permit removal of their component parts for inspection and repair. Process pumps and compressors are located out-of-doors with only the protection of a roof slab which also serves as a pipe rack. An exception to this is the cat. poly. plant where no protection is provided. This simplifies access for maintenance purposes. Equipment groups are separated by roads and access-ways having adequate clearance for mobile equipment.

The addition of future equipment such as pumps and exchangers was taken into account in the design. The main pipe racks have been sized to permit addition of another tier of piping to accommodate future requirements.

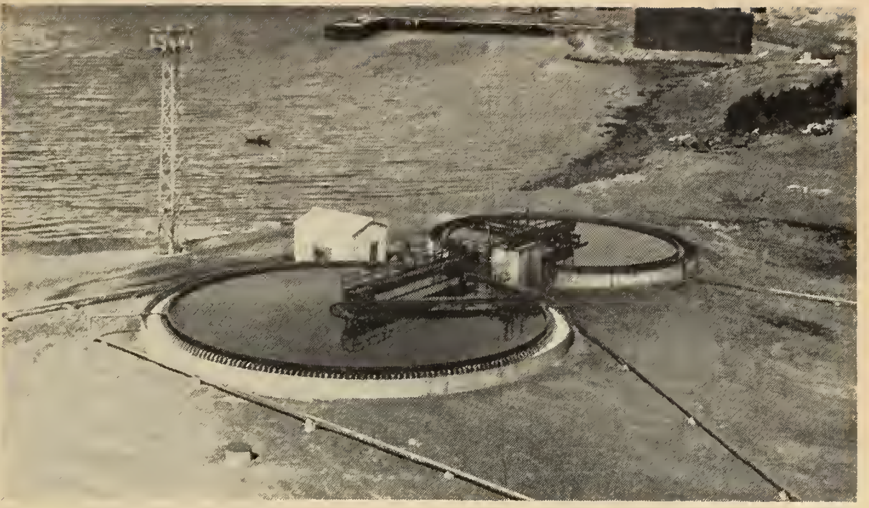


Fig. 7. Refinery separators.

Corrosion

It has been estimated that corrosion annually costs the petroleum industry $300,000,000. To minimize corrosion in the process equipment the following steps were taken in the design of the Halifax units:

(1) Extensive use was made of alloy steels, such as 11-13% chrome in the flash zones of a. & v. unit and cat. cracker fractionating equipment to resist high-temperature sulphur attack and use of 1¼% chrome, ½ molybdenum, in Powerformer furnace tubes and associated piping to prevent high temperature hydrogen attack.

(2) Use was made of refractory linings to a considerable extent, for example, the cat. cracker reactor, regenerator, and associated U-bends, and the Powerformer reactors are lined in this fashion.

(3) Injection of corrosion inhibitors into fractionation tower overhead streams was carried out to minimize deterioration of condenser equipment.

(4) To reduce the corrosive effect of salt water which is the normal cooling medium employed, the channel surfaces of all coolers are neoprene lined and aluminum brass tubes and tube sheets are used.

(5) Box coolers are refractory lined and the internal piping equipped with cathodic protection systems utilizing rectifiers.

It is the practice of Imperial Oil to obtain fixed price bids for the various projects where possible. All the process units and the utilities plant were included in one package and bids were requested from four major contractors, all of whom had previously completed large projects for Imperial.

Very extensive specifications were prepared by the engineering division of Imperial Oil Limited at Sarnia, Ontario, and these were furnished to all bidders. They included:

(i) Complete process design for all units.

(ii) Mechanical design and utilities specifications covering the new facilities.

(iii) Plot plans covering equipment spacing and location.

The contract covering this work was awarded in November 1954. The general contractor carried out all detailed mechanical and utility design within the limitations of Imperial's specifications, preparation of all construction drawings, material procurement and inspection, equipment application and actual construction. The main contract represented 50 per cent of the total construction program.

In addition to this contract, a large number of subsequent contracts were let to cover extensive offsite facilities required to integrate the new process area with the existing refinery. These included two new docks and complete renovation of a third, a salt water pumphouse, two refinery waste water separators, a waste disposal plant, offsite piping, pumping and electrical, extension and centralization of mechanical shops, a technical building, additional tankage, and an automotive garage. The complete engineering for the majority of offsite projects, includ-

Fig. 8. Waste disposal plant showing incinerator with trash destructor in the foreground.

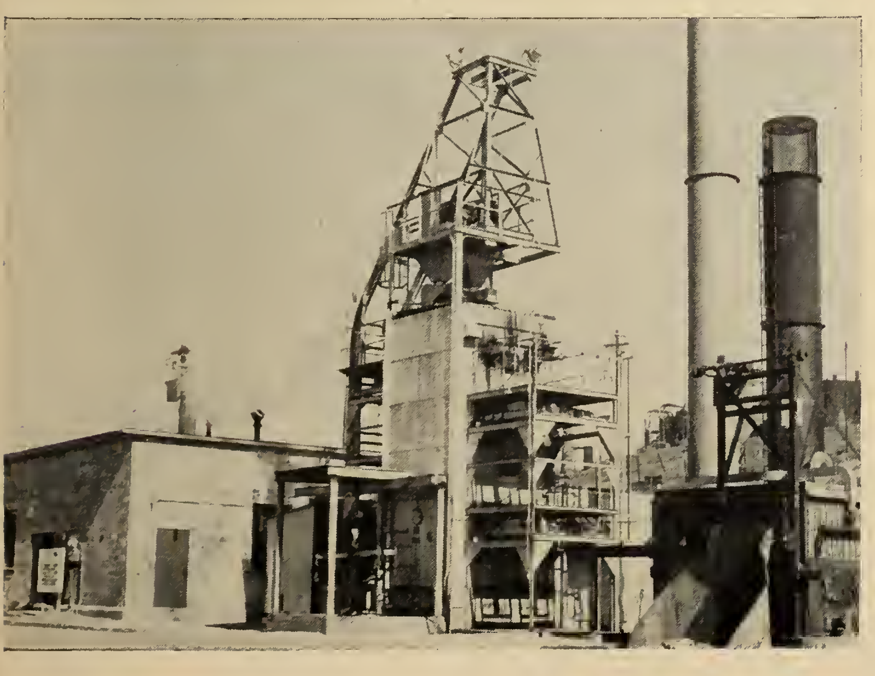


Fig. 9. 175 ft. high elevated flare and ground flare.

ing the preparation of all construction drawings and specifications was provided by Imperial's engineering division at Sarnia. An exception to this was the new docks which were designed by the consulting engineering firm of O. J. McCulloch and Company. To complete all phases of this construction program, nineteen separate contractors were engaged by Imperial Oil. The majority of these were Maritime firms. With the number of contractors working in the refinery, close co-ordination was required to ensure that construction work proceeded smoothly.

A considerable amount of water is required to cool hydrocarbon streams at various phases of the process and to cool products prior to sending them to storage. Salt water is normally used for this purpose. This is supplied by three 15,000 U.S.g.p.m. deep well pumps, of which two normally are in operation. This water flows through a 7-ft. diameter reinforced concrete intake line, laid some 160 ft. into the harbour, into a large concrete basin below the pumphouse. A travelling screen removes foreign objects, and chlorination prevents algae formation. The cooling water distribution lines inside the process area are cement-lined cast iron. The quantity of cooling water circulated is three times as great as the amount of water used by the City of Halifax.

Fresh water is in short supply in the area and is brought some two miles from Morris Lake. This is used for special services such as pump and compressor cooling and desalter operation where salt water would be unsatisfactory.

Halifax refinery is surrounded by residential and commercial developments. To make the plant a good neighbour, equipment was installed to minimize air and harbour pollution. Spent caustic from the treating plant is neutralized and sour water streams deodorized with hot flue gas prior to release to the sewer system. The malodorous materials removed are burned in the CO boiler.

Clean and oil-bearing waste from the new process area is carried through new 48-inch and 30-inch reinforced concrete sewers to two circular separators 75 feet and 60 feet in diameter. These facilities supplement the existing system which handles the remaining portion of the refinery. The separators are equipped with continuous top oil skimming and bottom sludge scraping facilities and are shown in Fig. 7. The efficiency of these separators is very high, with a hydrocarbon effluent content of only 5 to 7 p.p.m.

The sludge and oil removed from the separators are pumped to the waste disposal plant. They are slurried with a two-stage centrifuge system. The oil recovered is pumped back to the process area for re-running. The remaining material is transferred through a screw conveyor and an automatically timed skip hoist to an incinerator where it is burned. A smoke indicator in the incinerator stack automatically commissions secondary burners when the smoke density entering the stack exceeds the desired value. A trash destructor is also included in this plant to dispose of miscellaneous combustibles. This plant is shown in Fig. 8.

To dispose of surplus gases produced during periods of unit upset or when equipment is out of service for maintenance purposes, two flares are provided:

(i) a 24-inch diameter, 175-ft. high, guyed steel elevated flare equipped with a heat-resisting alloy tip which is designed for smokeless operation.

(ii) A refractory-lined steel-shell ground flare, designed to contain the flame inside the surrounding shell. These flares are shown in Fig. 9.

An investigation was made to determine the feasibility of mining underground caverns in the underlying rock strata to store butane, pentane, and liquified petroleum gas. After

Fig. 10. Supertanker at one of the new docks at Halifax Refinery.

Fig. 11. Typical hose handling tower at new docks.

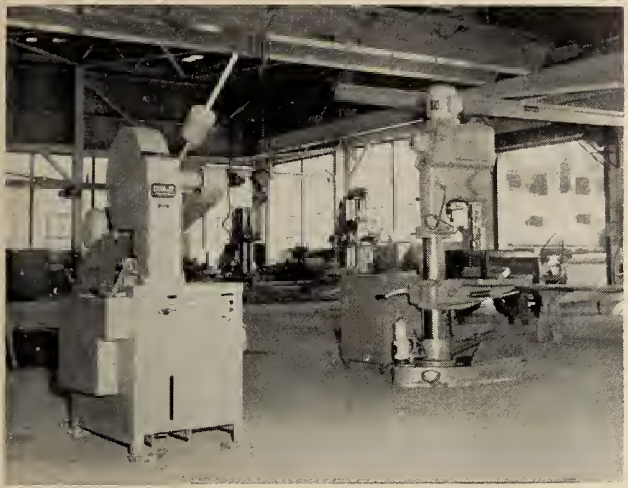


Fig. 12. View of one section of mechanical shops.

Fig. 13. Portion of storehouse facilities in mechanical shop building.

deep core tests had been taken it was decided that it was not practical. The underground strata were too porous and contained minerals which would have adversely affected product quality. Above ground pressure-storage, consisting of three 15,000-barrel butane spheres, a 15,000-barrel pentane hemispheriod, and five 30,000-U.S.g. liquified petroleum gas storage drums, was provided.

In addition to the above, approximately 1.3 million barrels of new tankage capacity was added to store the increased number and volume of products. Five 120 x 48 ft. floating roof tanks were built for crude storage service.

To permit grouping tanks in similar service and to tie new products into storage, loading, and transfer points, an extensive offsite piping and pumping program was required. Over fifty miles of pipe, ranging in size from one inch to thirty inches, was installed on new structural stanchions. Thirty field pumps mounted outside on slabs adjacent to their product source were also installed as part of the program. The majority of these field pumps are remotely controlled at tank car, tank truck, and dock loading facilities. Of particular note is the electronic gasoline blending system. The required blend is set up on a control panel in the Ethyl Building. This sends a pulse to the automatic control valves some one-half mile away to control the flow of each constituent making up the final product.

The existing docking facilities were obsolete and inadequate. These were replaced by two new docks, and a third dock was completely modernized. The new docks are capable of handling some of the largest supertanks afloat. Two 800-ft. supertankers and a T-2 can be handled simultaneously. A supertanker is shown at one of the new docks in Fig. 10.

Each new dock consists of two 40-ft. diameter cells of interlocking sheet steel piling which are filled with rock. The cells are tied together by 14-inch steel H-piles supporting a reinforced concrete deck. Similar piles tie each new dock to mooring dolphins and to shore, serving also to support the pipe racks and precast concrete roadways to each dock. The docks are equipped with spring fendering and rubber bumper block system to cushion impact loads from approaching ships.

Fig. 14. Technical building housing laboratory, personnel, medical, administrative and technical departments.

An additional ten miles of pipe were required to service the new docks. This piping permits crude to be unloaded at a rate of 20,000 barrels per hour and products to be loaded at rates up to 7,500 barrels per hour.

All three docks are equipped with motor driven mooring and hose handling facilities to reduce manual labour required. Hoses are taken from their stowed position inside the hose handling towers and accurately positioned over the ship's connections by hoists associated with these facilities. All hoists are remotely controlled from console panels on the operating deck. A typical hose tower is shown in Fig. 11.

As part of the modernization program, all maintenance crafts were consolidated in a central mechanical shop. Three existing buildings were joined together and considerably extended to provide additional shop space plus lunch, locker, and toilet facilities, and offices for craft foremen and the maintenance engineering group. New equipment, such as travelling cranes, horizontal boring mill, dynamic balancing machine, were added to speed up shop maintenance work. A view of one section of the shops is shown in Fig. 12.

Additional mobile maintenance equipment, such as a 25-ton crane, straddle truck, high lift truck and low boy was purchased to expedite unit turn-around work.

An enlarged storehouse forms part

of the mechanical shops building making materials readily available to the various maintenance crafts. Use is made to a considerable extent of palletization and mechanical equipment. Figure 13 shows a portion of the storehouse, one feature of which is automatic door opening equipment. The truck driver can push a button on the dashboard to initiate a magnetic signal which starts the door opening motor. After the door reaches its fully open position, a timing relay automatically starts to close it after 10-40 seconds. An electric eye guards the entrance to prevent the door closing on any object.

A new L-shaped technical building was included in this project. This was designed by a local firm of architects. One wing houses the laboratory where products manufactured are analyzed to ensure that they meet quality and process specifications. The other wing contains the management and technical offices, and the medical and personnel departments. This building is shown in Fig. 14.

Colour Scheme

A departure was made from the conventional black and aluminum colours which normally characterize refineries. In all, twenty-three different colours were used. The colour scheme of the new process area was selected to give an overall harmonious effect using greens, blues, beiges, yellows, reds, tans and whites. All new tankage was painted chalking white to reduce evaporation losses. The use of colours encourages good housekeeping, which in turn is reflected in fire and accident prevention. The final result is most impressive.

Construction problems arise on all projects. The principal problems faced at Halifax were primarily due to the necessity of building the new facilities on the site of existing refinery equipment which had to continue in operation to meet product commitments. This necessitated detailed planning and close liaison with refinery personnel in making changes and tie-ins to existing equipment.

Labour Force

As construction projects of this size and type are not common in the Maritimes, the local supply of skilled craftsmen was exhausted and some 200 men had to be brought in to the Halifax area from as far away as the Montreal, Toronto, and Winnipeg areas. During the peak period, more than 1,500 men were employed on the overall project with 1,100 concentrated in the main process area.

A large part of the construction was carried out under severe winter conditions. A record snowfall of 142.7 inches affected labour productivity and morale to some extent. Normal winter precautions such as protection of concrete, brickwork, and refractory were followed.

Labour relations on the entire project were, in general, very good. The project safety record was also excellent.

Imperial Oil was represented in the field by a resident engineer and field staff, which at the peak of the construction program consisted of five engineers, two inspectors, and two accounting personnel who closely followed the project in the interest of quality, economy, and speed.

Fig. 15. Erection of the feed splitter tower at the powerformer.

Use was made of x-rays, gamma rays, dye check and trepans to check welding quality. All trays, piping, electrical work, furnaces, boilers and vessels were subjected to very rigid field tests.

All major vessels which could not be shipped by rail were field fabricated. Special attention was paid to field welding techniques. Hoisting operations were co-ordinated very closely with the local weather bureau to minimize difficulties due to sudden storms which are prevalent in the area.

In the main, all piping both alloy and carbon steel was shop fabricated. This expedited pipe installation and minimized field required. Prefabrication of concrete sewer and electrical manholes was also carried out.

To clear the site for the new units, nine tanks had to be floated to a new location in improvised dikes. Following this, field construction in the main process area started from grass roots in April, 1955. Within seventeen months all major units, except the Powerformer, which was added at a later date, were in operation at or above design capacity. This was a major achievement in refinery construction.

Fig. 16. Divers laying 7 ft. diameter salt water intake line 160 ft. into harbour.

The Television Backbone of Canada

Transcontinental television network officially opened by the Canadian Broadcasting Corporation, 1 July 1958

"A MARI USQUE AD MARE", Canada's motto, meaning "from sea even unto sea", was given a new dimension in the field of communications and Canada's unity, on 1st July when the Canadian Broadcasting Corporation officially opened a backbone transcontinental television network with an hour-long Dominion Day production that featured "live" pick-ups from many parts of the network.

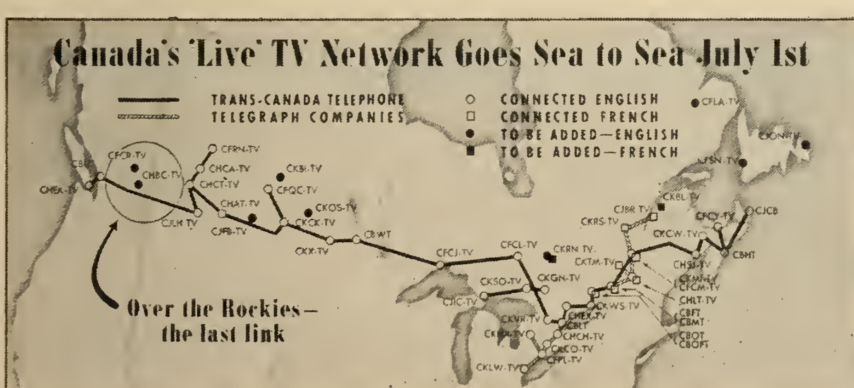
Fittingly, the television broadcast over the world's longest, publicly-owned microwave system marked the 91st anniversary of Confederation. This historical achievement has united 3,900 miles of Canada, enabling "live" television to be seen simultaneously in 3,000,000 TV homes.

Built at a cost approaching $50,000,000, the microwave project was a major engineering and construction undertaking that involved pioneering in a real sense. Pushing the chain of microwave towers across Canada meant struggling through some of the roughest terrain and the severest weather this country can offer.

The astounding engineering and construction problems behind this network, however, do not match the vital impact on Canadian life that will now occur with the CBC's use of this "sea to sea" backbone television "skyway" that links Sydney, Nova Scotia, with Victoria, British Columbia. For the first time, some 80 per cent of Canada's population can see national and special events on a simultaneous basis. This is not the final goal. A "link" is at present being constructed by the railway companies to extend the network from Sydney, N.S., to St. John's, Newfoundland.

The July 1st CBC telecast demonstrated how the CBC's network television service, linking both the CBC and private stations across the country, will now be able to knit the people of Canada more closely together. "A unique vehicle for telling the story of Canada, both past and contemporary, the CBC's television service will now become—even more than previously—the eyes of Canadians upon their nation", is the comment of J. A. Ouimet, M.E.I.C., CBC General Manager.

The sociological and economic changes that will take place in Canada with the full operation of the television skyway will provide a source of entertainment and give new scope to the talents and imagination of all Canadians. Simultaneous live television can now be brought into almost every Canadian TV home. Important national and local events covering every field of activity will be seen instantaneously across the entire breadth of Canada. Viewers who saw the March 31st federal election coverage this year numbered 5,600,000 and made up the largest audience thus far for a CBC television production. About 5,500,000 Canadians watched Queen Elizabeth give her address to the nation last October, and last fall's Grey Cup game drew an audience of 4,850,000.



There are 50 licensed television stations in Canada. Eight are CBC stations, two French and six English. Forty are privately owned. In addition, there are stations at Goose Bay and Harmon Field, Nfld., operated by U.S. Air Force personnel for servicemen and civilians in these areas. The stations are, however, under CBC management.

Video Tape Relay Centre at Calgary

July the first also marked "opening day" for the CBC's video tape relay centre at Calgary.

Canada's six time zones from Newfoundland to the Pacific (compared with just one in the United Kingdom and only four in the United States) make many problems for the CBC in scheduling programs for the full network.

For example, a program produced in Toronto at 8 p.m. Eastern time appears in the Maritimes' Atlantic time zone at 9 p.m. In Vancouver it is only 5 p.m. Pacific time, and a good percentage of viewers are still travelling home from work. Thus, the scheduling of such programs so that they appear at a convenient local time across the country, is an exacting job.

In the past, TV stations west of Winnipeg have been served by kine-recordings (television film) which might be delayed one, two, or three weeks by recording and distribution processes. The video tape relay centre in Calgary will now shorten the delay to a matter of an hour or so for most western stations. Thus network programs will be seen the same day at times more convenient to local viewers.

The CBC operates the relay centre, leasing space and distribution facilities. At the centre, live television signals are received over the microwave network and fed to six Ampex VR-1000 video tape recording machines. These machines capture both picture and sound on a reel of magnetic tape two inches wide. The tape is then rewound and the program played back from the recorder to two control booths where audio and video is monitored for quality. From these booths the program is transmitted at suitable local times, once for the connected prairie stations except Winnipeg, and again for Lethbridge and the connected British Columbia stations.

The VR-1000 greatly reduces the use of kinerecordings for television delays. Tape requires no processing, as does kinerecording, and can be re-used many times. One hour of programming can be recorded on a standard 4,800-foot reel of video tape.

The relay centre handles an average of seven hours of programming

The 350-ft. microwave tower at Olive, 40 miles north of North Bay, Ont. Largest in the Trans-Canada Telephone System's coast-to-coast microwave network, the Olive tower weighs 120 tons and contains the largest steel angle sections ever rolled. The huge antennae, each weighing 1,700 pounds, simultaneously transmit scores of telephone messages as well as CBC television programs.

daily and uses an estimated 663 miles of video tape per month.

On the VR-1000, the picture is recorded instantaneously on the tape by a high-speed rotating disc, containing magnetic recording heads, turning at 14,400 revolutions per minute while the tape passes at 15 inches per second. Sound is recorded and reproduced along the upper edge of the tape. Along the lower edge, a control track is recorded, to serve a purpose similar to that of the sprocket holes on a movie film. During the playback this track keeps the tape motion in step with the rotating head assembly.

Video tape is the latest development in television recording technique, providing high quality almost identical to the live program and ease of operation.

The microwave facilities are owned, operated, and maintained by the communication companies across Canada. The CBC rents the network to transmit its programs. Calgary was chosen by the CBC for the relay centre as this location requires a minimum of network facilities to provide efficient and economical relay service in the west.

CONSTRUCTION

Three major communication organizations have contributed to the provision of this coast to coast television network; namely, the Trans-Canada Telephone System, the Canadian National Railways and the Canadian Pacific Railway. The Trans-Canada Telephone System, which has built the major portion of the network, consists of seven member companies: The British Columbia Telephone Company, the Alberta Government Telephones, Saskatchewan Government Telephones, the Manitoba Telephone System, the Bell Telephone Company of Canada, The New Brunswick Telephone Company and the Maritime Telegraph and Telephone Company.

This major portion of the over-all network provided by the Trans-Canada Telephone System consists of the backbone structure from Sydney, N.S. to Victoria, B.C. and includes branch lines to Edmonton, Lethbridge, Saskatoon and Sault St. Marie. The railway companies provided a branch section between Toronto and Windsor and a section paralleling the Trans-Canada System between Montreal, Quebec, and Rimouski, the latter for transmission of French-language TV. Also the extension to St. John's, Newfoundland, mentioned earlier.

The Trans-Canada Telephone System's "skyway" comprises 139 relay stations on the backbone network and over 30 more relay points on the spur lines that add several hundred additional miles to the 3900 miles from the Atlantic to the Pacific.

Decision to build a microwave system to handle the ever-increasing number of long distance calls had already been taken when the CBC called for tenders for the provision of network television facilities to join Toronto-Ottawa-Montreal by 1953. The Bell Telephone Company of Canada was awarded the contract and, in May 1953, the link went into service—carrying telephone calls as well as television programs. A connection to Buffalo to connect with U.S. television networks had been placed in operation shortly before.

Further contracts to the Bell Company (acting on behalf of the Trans-Canada Telephone System) followed, and the huge task of spanning almost 4,000 miles of the Canadian landscape rapidly got under way. In the summer of 1954, a 180-mile link to Quebec City was opened by the railways and on 30 September 1956 the 1,200-mile Toronto-Winnipeg section was inaugurated by the Trans-Canada System.

The Saint John-Moncton-Halifax-Sydney section went into service in December, 1956; the Winnipeg-Regina section in April, 1957; the Regina-Calgary section and the Edmonton-Calgary-Lethbridge section in November, 1957. The Maritimes were linked with the main network on 2 February 1958, when the Quebec City-Saint John section and the link to Charlottetown came into operation. The Calgary-Vancouver section went into service on 1 July, marking the completion of the microwave network "from sea to sea."

Small Army Required

Establishing Canada's only transcontinental microwave system required the co-operative efforts of a small army of telephone and construction people, with the Northern Electric Company manufacturing and installing the complex electronic equipment.

After picking out a tentative route from topographical maps, engineers path-tested the transmission between adjacent tentative sites. This was done by mounting small antennae on temporary aluminum test towers that could be erected to a height of 200 feet in a matter of hours. The testing might indicate that the site was unsatisfactory because of reflection or because the path was blocked by a hill or other obstacle. They also indicated the height of tower required —usually between 50 and 200 feet, though there is a 350-foot tower at one site near Olive in Northern Ontario.

Then bids were called from contractors for the foundation and tower erection work. Roads were built—usually short—but in one B.C. site 12 miles long; sites were cleared of trees—as much as six acres in some locations—to act as a fire-break; power was brought in and other facilities provided.

The towers are galvanized steel structures anchored to four concrete footings containing a total of 170 cubic yards of concrete. Weighing as much as 120 tons, the towers are so strong that even in a 100-mile an hour hurricane they will not be deflected more than half a degree.

To build mountain-top relay stations for the Trans-Canada Telephone System's microwave network to the West Coast, roads had to be cut through mountains, even above cloud level (upper left). At Hedley, B.C., a mountain top was blasted away to form a site (lower left). So high are many of the sites that buildings are often buried in snow (upper right). Access roads could not be built at two sites, so aerial tramways were constructed. The Dog Mountain tramway (lower right) is one of the biggest in the world—more than two miles—with a lift of 4,400 ft.

Problems

Winter and summer, in snow and mud, on mountain-tops and in forest, by truck and snowmobile and aerial tramway and even helicopter, the work went on unremittingly in order to meet the 1 July date for transcontinental television and telephone service over the new "skyway".

At Dog Mountain, near Hope, B.C., a massive steel microwave tower had to be erected on a 4,840-foot mountain peak. First, men and equipment were flown in by helicopter to test the transmission. Then, permanent means of access was required. A road was impracticable, so an aerial tramway 11,800 feet long with a lift of 4,400 feet had to be built. All through the winter construction men struggled in bitter cold, fog and snow. Food supplies came in by helicopter. Often buildings were literally buried in snow. Finally the tramway, one of the world's biggest, was ready. Now the heavy equipment could be lifted in and soon another microwave tower rose to the sky.

A second, shorter, tramway was required at Crow's Nest Pass in Alberta.

The mountains presented plenty of other problems. At Hedley, B.C., the rocky peak measures only 65 by 75 feet, with precipitous drops on every side. Here rock was blasted to level the site, and the foundation of the equipment building had to be extended 13½ feet down the edge of the cliff.

At Creston, B.C., the two-mile access road has a 20 per cent grade and 33 switchback turns. At another site a 12-mile access road had to be built. Ten of the 13 sites in British Columbia are on mountain ridges, the highest 7,000 feet above sea-level. And always in the mountains the workers had to keep a wary eye out for bears and rattlesnakes.

But each area of the vast country had its particular difficulties. In the prairies the deep gumbo soil offers poor anchorage for the 100-ton towers and footings have to be extra large and of unusual designs to provide the needed rigidity.

In Northern Ontario there is a forbidding mixture of forest, brush, muskeg, swamp, and rocky hills. Forest fires are a hazard so at least six acres of land was cleared around each site; Indian workers were hired to do the job.

There was pioneering, too, in other aspects of the $50,000,000 project. Design of the network was a major engineering accomplishment with many "firsts" for Canada. For example, a method of "stacking" both a television program and scores of telephone circuits on the same channel was implemented in the Trans-Canada microwave system for the first time anywhere, with resulting economies because fewer channels and less equipment were required.

In manufacturing, production equipment had to be designed and installed to make the delicate electronic equipment in quantity.

Railway Contribution

The railway contribution presented construction problems in Quebec's northern bush when Canadian National and Canadian Pacific Communications were adding a link to the French television network and a line to Jonquière, Que., on the same network.

But in spite of tight schedules and natural obstacles the line was built right on time. So tight was the timing, in fact, that the system was extended to Jonquière on the very day the network was scheduled to go into operation. It pushed the railway-operated CBC French network from Montreal through Quebec, Three Rivers, Sherbrooke, Jonquière, and Rimouski.

Engineers had other problems too. One incident involved the purchase of land for an access road to a microwave station site. All 3000 feet of the road was in the hands of 19 owners and involved the use of maps dating back to the early 1700's.

Typical of the speed and precision involved in building such lines was the way in which engineers constructed the CNT-CPC network, in Southwestern Ontario, one of the earlier completed lines in Canada.

The line was first installed with temporary and mobile equipment so network transmission could begin immediately. Construction men then doubled back and built a permanent network while service continued uninterrupted.

But it is in Newfoundland, where construction of the final link in Canada's trans-continental TV network is beginning, that Canadian National Telegraphs faces its most formidable problems.

At Cape North, on the tip of Cape Breton Island, for instance, CNT must construct a station with a 200-foot tower located 1400 feet above sea level to carry television signals in a line of sight 69 miles across Cabot Strait to Red Rocks, Newfoundland. At Red Rocks the tower will also reach 200 feet and the site is 650 feet above sea level. It is the longest cross-water path in the country.

The two towers will each support two sets of antennas, spaced vertically apart so that if the signal decreases or increases on one set of antennas the opposite effect will be obtained on the other set.

Special devices will combine these two signals to produce a constant signal and thus overcome the fading which is characteristic of long over-water paths. This technique is known as diversity reception.

Each station will receive a signal of about a millionth of a watt and retransmit the signal at five watts. This is from five to ten times greater than the power normally used in equipment of this type and will result in greater reliability of service.

OPERATION

The type of microwave radio relay system provided by the Trans-Canada Telephone System is known as TD-2. This system has been described very adequately in a previous article in *The Engineering Journal*[1] and therefore will only be touched on briefly here. The system operates in the frequency band 3700-4200 Mc/s. and a single structure accommodates six radio channels in each direction. Each of the radio channels can handle one monochrome or colour video signal or upwards of 480 telephone channels.

To provide greater reliability, one radio channel is assigned as a stand-by facility. A breakdown in any portion of the network is automatically detected and the standby switched into service to bridge the break in a fraction of a second. Radio relay stations located along the TD-2 route at intervals of approximately 30 miles are completely unattended. Troubles occurring in these remote stations are automatically detected and an alarm sent out to a master control and alarm centre. By means of an intricate interrogation system, an attendant can identify the type of trouble and immediately dispatch a trained maintenance technician. During inclement weather in winter, difficulties are encountered in gaining access to some repeater locations despite the best engineering efforts in the system design. To overcome these handicaps, maintenance people use all types of transportation: snowmobiles, snowcats, tractors, jeeps, aerial tramways.

With a structure such as the TD-2 system, one or more television program facilities can be made available at the same time to meet this vast country's communication needs.

The video tape relay centre at Calgary.

Use of Network

A full understanding of the operation of this network requires first of all an appreciation of the centres of population, the points of origin of television network material, time zones, and last, but not least, Canada's two languages.

The main centre for the origination of English-speaking program material is the Canadian Broadcasting Corporation studios in Toronto. At this point also U.S.A. network programs are received from Buffalo, N.Y., and fed to CBC studios where they are monitored and re-edited for commercial material and fed back into the network as required.

French network program material originates in CBC Montreal and is fed into the French network at that point. There are also a number of other CBC program centres across Canada, namely, Winnipeg, Vancouver, Halifax, and Ottawa. There will also be from time to time special-occasion temporary insertions of program material at any number of Canadian points, for example, the Calgary Stampede at Calgary. All of these were provided for in the design and layout of the television network.

To meet the individual needs of the various sections of the country's population from the point of view of density, community of interest, time zones, etc., the corporation has divided the network into roughly five parts: the Maritime, Quebec, Ontario, Prairie, and Pacific networks.

For part of a program day each of the individual networks' air material is of local origin and during this period the networks are set up in that manner.

However, for other portions of the program day, networks use material produced in Toronto and therefore require connection to that point. In

(1) Microwave Radio Project of the Trans-Canada Telephone System, by A. J. Groleau, M.E.I.C. *The Engineering Journal,* 1956, v. 39 n. 8, August.

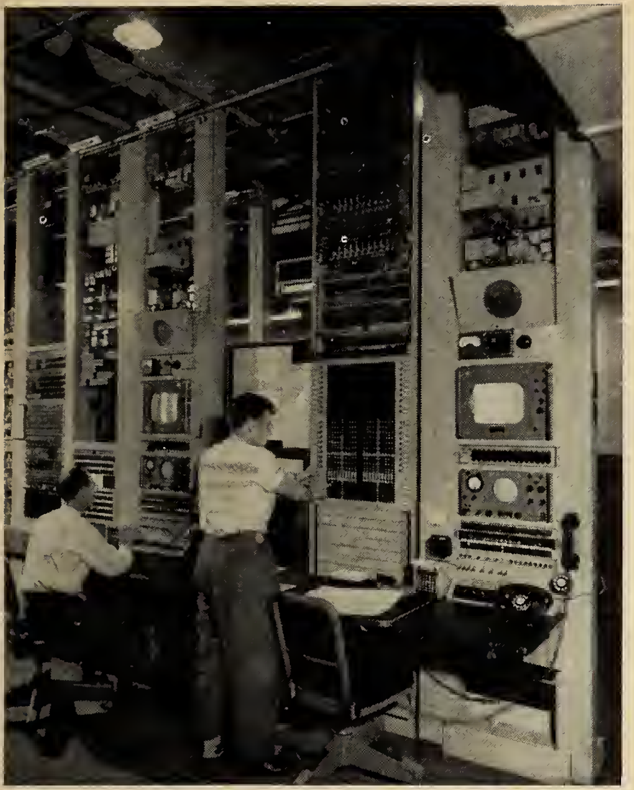


Fig. 1. View of television operating centre showing the switch control unit and monitoring positions on either side. Attendant is making a switch.

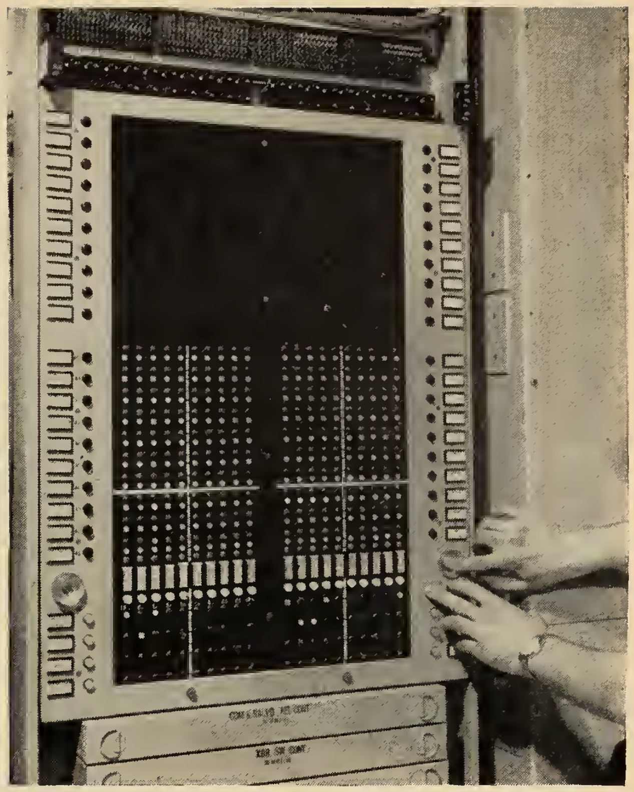


Fig. 2. View of switch control panel located in television operating centre.

the case of the Maritime network this is done by connecting Toronto to the Halifax studios directly and then feeding back into the Maritime network at that point. Montreal and Ottawa can be connected to the same feed from Toronto if desired or served by a duplicate feed.

Similarly TV stations between Toronto, Ont., and Winnipeg, Man., are served from Toronto over the western branch of the network. The same material as fed to Halifax can be used or, if required, different material may be used since the network can be simply divided at Toronto. In fact, at any point where there are CBC studios the network can be broken to feed material either independently east or west or simultaneously.

West of Winnipeg, due to the time zone difference, it has been found desirable to delay a broadcast originating in Toronto by a period of two to three hours. This is being accomplished by passing the program from Toronto through to Calgary. Here it is fed to the CBC video tape relay studio, mentioned earlier, where the program is recorded on tape and at the appropriate hour re-inserted into the Prairie or Pacific networks. This, of course, requires the use of both east and west-bound facilities between Calgary and Brandon simultaneously.

Material of national interest required to be received simultaneously throughout Canada, or the North American continent for that matter, causes no insurmountable difficulty because the design of the system envisaged such requirements.

A nation-wide program such as the federal elections or a Royal visit requires the insertion into the network of material at widely separate locations. This is provided by duplicate facilities, intricate switching mechanisms, and close co-ordination between the CBC and the Communications companies.

Television Operating Centres

Control and switching of such a network is accomplished at the television operating centres (TOC) operated and maintained by the telephone companies (Fig. 1). To appreciate more fully the complexity of such a control point a description of the Toronto centre follows.

Toronto is a main hub of the Trans-Canada Telephone System network. Three major microwave routes converge at this point: (1) a route to and from the U.S.A. through Buffalo, N.Y.; (2) a route to Western Canada via North Bay and Winnipeg; (3) a route to Eastern Canada via Ottawa and Montreal.

In each route, radio channels assigned to the CBC television network are connected to the CBC studios through a television operating centre.

The basic functions of this centre are:

1. The termination of all video facilities under its control.
2. Rapid switching of audio and video facilities.
3. Rapid detection of trouble throughout the system and the control of restoration facilities.
4. The monitoring and testing of both audio and video facilities.
5. Centre of communication with all broadcasters and maintenance personnel for the reporting and clearing of trouble.
6. A point of adjustment of all video facilities, both microwave and cable, controlled by the centre.

To perform the above functions a TOC comprises:

(a) Terminating equipment such as equalizers, level adjusting amplifiers, impedance adjusting devices.

(b) Switching equipment.

(c) Switching control equipment.

(d) Testing and monitoring equipment.

(e) Communication centre.

A simplified schematic of a typical television operating centre is shown in Fig. 3. This shows the termination of video and audio trunks from the cities, television studios, and pick-up points The heart of the operating centre is the switch control arrangement shown in Fig. 4. The nerve centre of this is a control panel (Fig. 2) fitted with an array of coloured lamps and push buttons. The panel merely actuates video and audio switches which are located, for transmission reasons, as close to the terminating or switched equipment as possible. This switch panel not only activates switches in Toronto, but also remote switches located many miles away. This is accomplished by extending the control leads over wire lines to the remote point.

For example, the feed to Peterborough which is taken from the backbone route at a remote repeater station can be reversed, re-established or restored, by the push button controls on the Toronto panel.

The switching operations at a TOC make possible switching functions which vary from very simple connections to a complete re-arrangement of the network. For example, by means of pre-select buttons, a new arrangement of the network can be set up in advance of the actual switch time. To eliminate errors, white lamps indicate the arrangement that has been selected. The arrangement of a network program in progress is displayed by red lights. At the instant of switch "cue" the operator merely pushes a "salvo" button and a specially marked "execute" button and in a fraction of a second the new network is established.

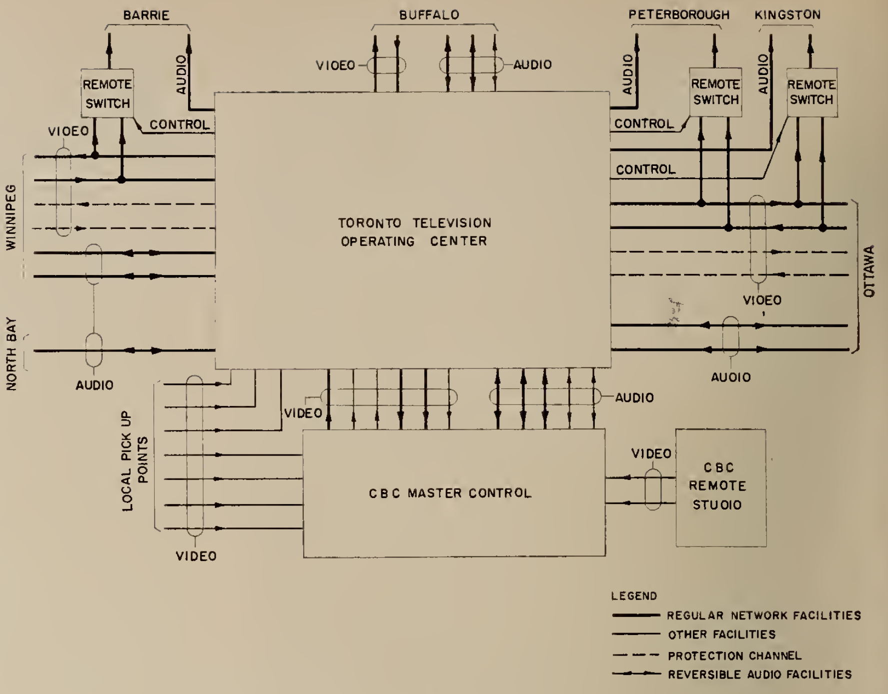


Fig. 3. Television network switching in Toronto.

The speed of operation of the switches is so fast that the change is hardly detectable.

Figure 4 also shows a video monitoring and test position linked to the switch control panel. The monitoring position consists of a high quality picture monitor and oscilloscope. From the test position, various video wave forms and multifrequency signals can be transmitted into the network and monitored at distant TOC's. Thus test centre attendants can quickly observe the performance of the system and make minor adjustments of signal level and frequency response. This is a routine performed daily at line-up time just previous to turning the network over to the CBC.

CBC master control is also equipped to transmit and receive these same signals and test patterns. These are jointly observed by CBC and the communication companies, thus obtaining an overall studio-to-studio performance check just before program time.

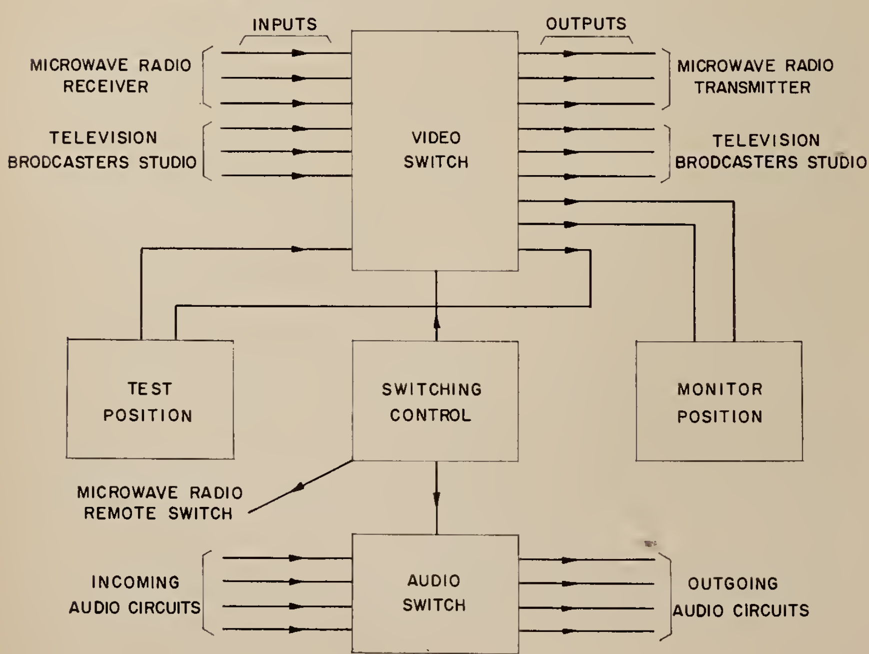
Few adjustments can be made to the network by the communication companies during the program period. It is therefore essential that an extremely high degree of stability be built into the network.

Major adjustments to, and testing of the network, require longer and more detailed attention and are performed at regular intervals as established routines by the Communication companies.

To keep failures to a minimum the network has been equipped with spare equipment, standby video loops, standby power, and standby radio channels. Most of these facilities are arranged for automatic restoration or manual push-button switch-over.

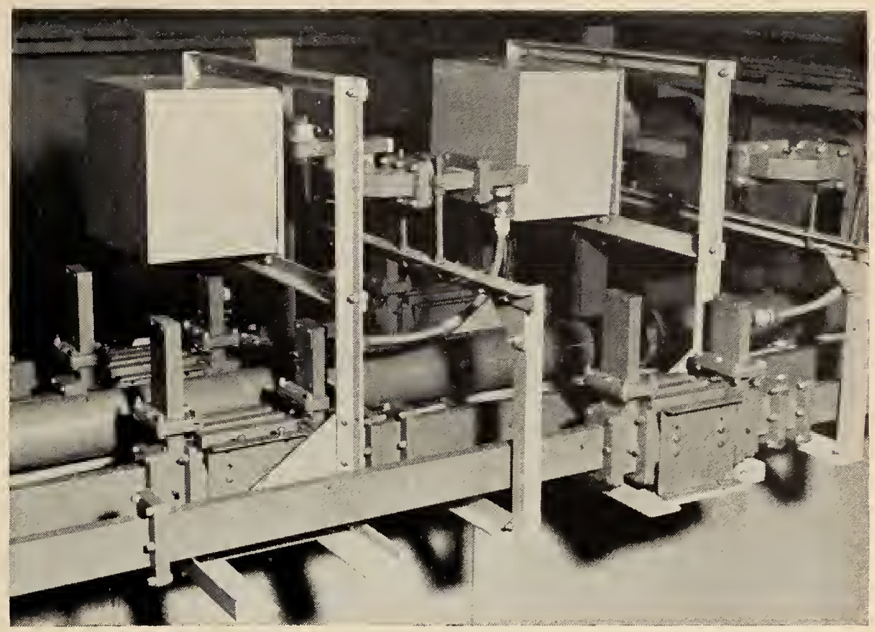
Due to the length of the system and the intricacies of the equipment, some failures are inevitable. Peculiar weather conditions upset the operation of radio channels. Occasionally, an antenna or a waveguide may be

Fig. 4. A typical television operating centre layout.



punctured by a hunter's stray bullet. These things occur infrequently and in the overall it is expected that the Trans-Canada network will maintain a high record of reliability due to safeguards and extra insurances built into it.

Little has been said of the audio or sound portion of the television service. It, however, is just as important as the video portion. Oddly enough, the sound portion of the TV program is not transmitted with the picture over the network. Normal practice is to use a network of high quality land-line facilities, with alternate standby, in many cases, over program channels on the microwave system. The facilities provided by the Trans-Canada Telephone System use high speed line carriers. This is essential to reduce to an acceptable minimum the delay at the observing point, between the picture and sound.



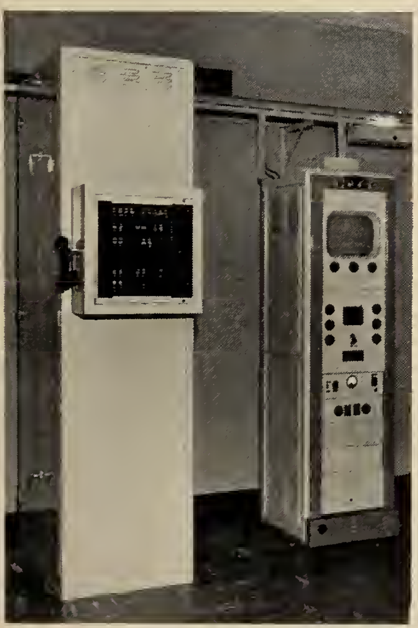
Waveguide runs; CN-CP microwave system.

Short Radio Waves

Making all this possible in the Trans-Canada's microwave system, are radio waves of the order of three inches in wavelength, compared with 10,000-inch wavelengths of the ordinary broadcast channels.

These microwaves have many of the characteristics of light. For example, microwaves—like light—travel in straight lines and once over the horizon, they fail to return to the surface of the earth at a predictable point. This means that the range of reliable transmission is limited to line-of-sight, and the relay points (even taking advantage of high land and tall towers) are on the average only 25 to 30 miles apart.

Supervisory and monitor bays in the Canadian National / Canadian Pacific microwave system.



On the other hand, microwaves can be focussed into a beam and aimed directly at a receiving antenna so efficiently that only half a watt of power—about the amount needed to operate a flash-light bulb—is needed to span the distance between the two stations.

Since the microwaves have the velocity of light (186,000 miles a second) an event being televised from Victoria would be seen at Sydney a mere 1/50 of a second later.

CONCLUSION

It is important to note that while the Communications companies handle the technical operation of this television network for the CBC, the CBC on the other hand maintains similar controlling and monitoring facilities to achieve the necessary broadcast standards. At this point, numerous problems exist since the network must not only perform with technical perfection, but, it must also maintain certain standards of quality broadcast performance, to enable the CBC to supply full value on a production and artistic basis.

Joint technical committees made up of personnel from both the CBC and the Communication services meet frequently to discuss problems and to find methods that will maintain quality broadcast performance. It is extremely vital to the success of the network that constant steps are taken towards a mutual understanding of the many varied problems.

Probably the most difficult problem faced by the CBC and its networks suppliers is one which is common to comparable organizations in the U.S.A. This is the difficulty of determining the nature and the degree of degradation which can be tolerated in the composite television wave forms before significant impairment of the television picture occurs. Next to this problem is the difficulty of measuring wave form impairments, which in some cases can be very slight while at the same time their effect on the final picture is quite serious. Thus, in the role of customer, the CBC tends in the interests of high broadcast standards, never to be satisfied with the performance of its leased network services.

The existing close co-operation provided through the medium of joint technical committees is constantly dealing with many minor and a few major problems which are fundamental to good television service and the effect of this work is to supply the Canadian public with a continuing improvement in the technical quality of the programs they see and hence a greater return on their investment.

Canadians everywhere can take pride in their television network. To Canada belongs the distinction of establishing the longest stretch of television network facilities for public service in the world.

DISCUSSION

of Technical Papers and Other Articles

THE MANICOUAGAN POWER DEVELOPMENT

J. M. Higgins, and Charles Miller, M.E.I.C.

The Engineering Journal, 1958, July, p. 60

F. L. Lawton,* M.E.I.C.

The paper on the Manicouagan hydro-electric power development, as one in the symposium on the Baie Comeau plant of the Canadian British Aluminium Co. Ltd., is significant because it demonstrates in a very positive manner the advantages of the thoroughgoing study of a project by hydraulic models. The achievement in unwatering the site for the McCormick dam, without the use of cofferdams, rests partly on the recognition of the site potentialities. However, the actual achievement rests on the confidence provided by the extensive model studies, it would appear.

The diversion tunnel, of 35 feet equivalent diameter and 20,000 c.f.s. capacity, with the floor at the intake end 70 feet below river level constitutes a fairly unusual diversion. It would be interesting to have the authors' explanation for the 3 feet lower water level above the dam than shown by the model tests. Was this due to lower tunnel friction losses or to superior entrance and exit conditions?

Following closure of the diversion tunnel, was any rock smaller than 2 cu. yd. in volume found on the invert downstream from the closure?

During stage II construction, blasting was apparently controlled by seismographs in the powerhouse area, the allowable amplitude of vibration being set at twenty-thousandths and actual amplitudes "— for the most part — were not more than 50% of the figure allowed". Did these actual amplitudes cause any relay tripping?

Reference was made by the authors to the difficulties associated with removal of "the timber crib which was placed during the first stage of construction as the connection piece between the section of the headworks then built and the rock-filled dam connecting across the future headworks intake area." Would the authors care to state if they would follow the same procedure if they were building stage I again?

With reference to the use of the L.S.T. for transport of the turbine runners, upper bearing brackets and the auto-transformers through the Manicouagan estuary, what was the depth of water at high tide and the draft of the loaded L.S.T.?

*Chief Engineer, Power Department, Aluminium Laboratories Limited, Montreal.

Authors' Reply

Mr. Lawton's comments are well taken. In reply to his first question the 3 ft. lower water level above the dam was due to a gravel bank which existed in the bed of the river. As the water level decreased with an increase in velocity, this bank was washed out and lowered the level immediately above the entrance.

In reply to the question about rocks smaller than 2 cu. yd. found, none were observed larger than 2 cu. yd. Rocks could be heard rumbling along the tunnel floor for about two or three hours after the diversion.

The blasting control records indicate that vibrations as low as 0.0023″ were sufficient to upset oil level controls. To overcome this a knife switch, in parallel with the mercoid switches, was put in operation and used on every blast. This procedure satisfactorily prevented the switches from tripping.

The timber crib constructed during the first stage of construction would not be repeated if we were carrying out a similar program in the future, but rather it would be more economical to construct the whole of the headworks in concrete in the first instance.

The transport of the turbine runners, upper bearing brackets and the auto-transformers through the Manicouagan estuary required at least five feet of water at high tide over the sand bars, and the L.S.T., when loaded, had a draft of 36″. It was necessary in every case to come up the estuary on a rising tide.

FORCES INVOLVED IN PULPWOOD HOLDING GROUNDS

R. J. Kennedy, M.E.I.C.,

The Engineering Journal, 1958, January, p. 58.

C. B. Dunham†

Professor Kennedy's paper is a significant contribution to the knowledge of the strain on holding grounds.

I understand there are several holding grounds in Eastern Canada receiving 200,000 to 300,000 cords of pulpwood annually; new installations average one a year, and may cost up to $1,000,000.

The stress tables will aid those responsible for designing, constructing and maintaining holding grounds to assess the risk of wasting money in over design in the holding ground against the loss of wood from broken booms or piers.

The holding grounds covered by the study cross the channel from bank to bank are designed to catch individual logs 4 to 16 ft. long.

Members will be interested in the recent development of bundle driving on the Fraser River in British Columbia. Here the bundles are guided by river boat to the holding ground which occupies about one quarter of the river channel.

The Fraser river rises in the interior plateau and flows in a 200 mile canyon through the coast mountains, then through a wide valley for 50 miles to tidewater. May 1 to Sept. 30 is high water with an average flow of 130,000 c.f.s. and a rise of 40 to 70 ft. in the canyon.

The 60 mile section of river below the canyon was improved between

(Continued on page 166)

† Director of Forestry Operations, Columbia Cellulose Company Limited, Vancouver, B.C.

ABSTRACTS

BASED ON CURRENT ENGINEERING LITERATURE

AUSTRALIA'S FIRST REACTOR

Engineering, v.185 n.4808, May 1958

Last April the Australian Atomic Energy Commission's research establishment at Lucas Heights, near Sydney, was opened. This is the first nuclear reactor in Australia and is called "Hifar" (short for high-flux Australian reactor). Construction began in October 1955.

Recruitment of the senior research staff had been mostly completed by mid-1955. They began work at the UKAEA research centre, Harwell. Subsequently, other scientific and assistant staff was engaged, bringing the total up to its present level of about 250. The first laboratory was occupied in December 1956 and by 1957 analytical services, workshops, design offices, electronic instrumentation, library and health physics facilities had been provided. About this time work on the laboratories research program was begun and developed.

The main objectives are as follows: (1) development of atomic power reactors suitable for Australian conditions; (2) research into problems associated with power reactors such as fuel and moderator purification and fabrication, chemical processing of spent fuel elements, and treatment of radioactive waste products; (3) to provide isotopes and radiation sources for which there are rapidly expanding uses in industry, agriculture, medicine and research; (4) to provide a national centre with equipment and trained staff facilities to aid Australia in the development of the use of atomic power, and to provide any specialist advice or experimental facilities necessary for this task; (5) to train scientists and technologists in atomic energy techniques.

The reactor types selected for investigation were chosen on the basis that the program should not duplicate work already done elsewhere and in advanced state, and also that it could be carried out on a cooperative basis with other countries, particularly the United Kingdom. The reactor systems are to be adaptable to the small power systems Australia is likely to provide outside the larger industrial areas in New South Wales and Victoria.

Research is being undertaken on two systems, the first and perhaps most promising is the high-temperature gas-cooled system using beryllium as a moderator, which has advantages over equivalent graphite systems for small electrical generating units in the range 5 to 20 Mw.; and the second, a liquid metal fuel reactor system using a sodium slurry as the coolant and fuel carrier.

TRANSFER PLANT PRODUCES STRUCTURAL STEELWORK

The British Constructional Engineer, v. 8 n. 5, March 1950.

A transfer plant for the production of structural steel sections, combining three machines into one integral unit which can cut and drill steel sections, has been built in Britain. Basically the plant consists of the three machines served by a power-driven roller conveyor system and other mechanical handling aids.

The first of the machines is a cold saw and the steel sections are conveyed to this by rollers through a hatch from the stockyard. After trimming of rough ends, a measuring device, with provision for fine manual adjustments, marks off the required length, and the section is fed forward into the jaws of the sawing machine vice. Any length of up to 40 ft. can be cut, and the measuring and cold sawing is controlled by an operator from the control cabinet. Machine scrap is ejected down a chute and usable ends are returned to stock.

After cutting. the sections pass on to a horizontal drilling machine which makes the holes in the flanges. On its way between the two machines the section can be shunted to one of several laybys if not immediately required. Any number of holes up to 12 can be drilled simultaneously. Spindles are arranged in four sets of three mounted on a horizontal cross-slide and can be raised and lowered by a feed-screw. A 4-speed gearbox gives a range of speeds suitable for drilling hole 5/16 in. to 1¼ in. in diameter, and a wide variety of patterns can be set for the drills.

The final machine to which the sections pass is a 4-spindle vertical machine for drilling holes in the webs. As in the horizontal drilling machine the spindles are adjustable and are also equipped with gags allowing any required number to be selected without removing the drills. Finished sections are moved from the machine by cross-feed dogs to a delivery point, and from here they are conveyed by roof gantry to the last lay-by for assembly, painting and despatch.

Any of the machine processes can be by-passed. Since the plant was installed, with an addition of only four men to the payroll the turnover of the company has been doubled. Men can be instructed to operate the machines very quickly, most of them being unskilled or semi-skilled. Output, depending upon the type of work, varies between 60 and 150 tons a week.

AEROTHERMODYNAMIC TEST PLANT

The Engineer, v.205 n.5333, April 1958

A high altitude test plant to be used principally for the testing of ramjets by Bristol Aero-Engines, Ltd. has been recently opened. It is the only one in operation in Britain such that the test cell can be evacuated to reproduce the conditions of running at high altitude. The pressure in the test cell can be brought down to 1½ p.s.i.a., for zero mass flow, by steam ejectors. At present ramjets up to 32 in. in diameter can be tested although 36 in dia. engines could be handled with minor changes. The pipework has been made initially of mild steel and thus working temperatures are limited to 450° C. Consequently Mach number 3.5 cannot be exceeded until chrome-molybdenum piping is in use.

The ejectors are run for high and medium altitude tests and compressed air is supplied to the plant for low and medium altitude tests. Up to four "Proteus" Mark III compressors can be used for air supply. The motors have a total rating of 26,000 h.p. for two hours or 21,000 h.p. continuous; two compressors can be driven at 12,000 r.p.m. to give 84 lb. per sec. at 8 atmospheres pressure and 315° C. temperature, or 4 at 11,000 r.p.m. delivering 150 lb. per sec. at 6 atmospheres and 260° C. An electric heater of 1,500 kw. and two coolers using up to 50,000 gallons of water per hour may handle all or part of the air flow; 80 lb. per sec. of air can be raised from 260° to 350° C. for ten minutes and outlet temperatures up to 450° C. are available; the coolers can reduce the maximum air flow of 160 lb. per sec. to 95° C.

The test cell is 75 ft. long and 10 ft. in diameter, weighing 108 tons. It has been tested to extreme pressures of 90 and 1.0 p.s.i.a. Water-cooled glass windows face the control room, and a series of glass windows are also incorporated which are shattered by explosive charges if the pressure in the cell during a test exceeds the safe limit of 25 p.s.i.a. At the rear of the cell are water sprays to cool the exhaust. Exhaust gases leave the cell for a silencing tower by means of an underground ductwork. To reduce the risk of damage by an accumulation of unburnt fuel vapour in the tunnel, Graviner explosion suppression equipment is installed to flood the duct with chlorobromomethane if light is sensed by the detector.

The ejectors can expend up to 98,000 lb. of steam by exhausting the accumulators under maximum flow in 6¾ minutes. This steam can be replaced in 2½ hours by three oil-burning boilers.

Engine fuel tanks hold a total of 26,000 gallons. There is no indication of fuels other than hydrocarbons being used. In the opening ceremony a "Thor" was ignited at a simulated Mach 2 at 30,000 ft.; for a 16 in. diameter engine this corresponds to approximately 1,800 lb. thrust.

The cost of the plant, as distinct from the buildings and services is understood to have been met by the Ministry of Supply.

HYDRAULIC PROBLEMS SOLVED BY GIANT WORKING MODEL

The Consulting Engineer, v.14 n.4, April 1958.

Despite research carried out over a period of 100 years by topographers and engineers, San Francisco Bay, California, has long posed problems which have remained unsolved. The huge crescent bar menacing the approaches to the Golden Gate is created and maintained by forces still unknown; the slow drift of sediment into ships' channels is unmeasured and unconfined; and salt intruding from the sea into the fertile region at the confluence of the San Joaquin and Sacramento Rivers, is a dangerous and unmeasured enemy to all whose living depends on the land surrounding the area of the bay.

To study these and a score of other problems, U.S. Army Corps engineers at San Francisco have designed and started to build an exact scale model of the Bay at Sausalito, California. The complete replica of the bay covers one full acre. It is built to a horizontal scale of 1 ft = 1,000 ft. and a vertical scale of 1 ft. = 100 ft.

Although the model does not look exactly like the real bay its action is similar to that of the prototype in reproducing to proper scale the rise and fall of the tide, flow and currents of water, mixing of fresh and salt water, and indicating trends in the deposition of sediments. The overall investigation is scheduled for completion in 1960.

The model was constructed principally of precast, lightweight, reinforced concrete slabs, each weighing some five tons. The rise and fall of the tide and accompanying tidal currents in the model bay are created by generating the tide in the model ocean. Salt water is pumped from a storage pump into the ocean headbay. Ebb and flow are regulated by an automatic tide-control operating a motor-driven valve in a separate outflow pipe connecting the headbay and sump. One tidal cycle requires 14.9 min. River flows are introduced from separate water supply systems around the model. Precise instruments measure elevations of the water and its velocity and salt content. When the model is adjusted so that these and other measurements agree with similar measurements from the actual bay, the model acts to scale the same as in nature. Physical changes made in the model will then show what effects would be in the bay itself. The action of silt is simulated by a light bituminous material called gilsonite.

To determine the effects of a salt water barrier on the bay, a miniature barrier and related works in the model are operated according to plan. By comparing measurements from the model of water-surface elevations, flows, current velocities and directions, mixing of fresh and salt-water, and deposits of silt, with and without the barrier, forecasts can be made of what would happen if a barrier were to be constructed. Deposits of mud and silt in bay shipping channels continually interfere with vessel traffic. An average of 8 million cu. yd. of material are dredged annually at a cost of about two million dollars. From measurements in the bay, analysis of dredging practices, and model experiments, specific information is obtained on the complex factors producing shoaling. Tests of remedial measures are conducted in the model.

PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS: HIGHWAY DIVISION

v.84 n.AW2, May 1958. Paper 1625

Trip origin and destination necessary for realistic highway location and design may be outmoded if they do not reflect current economic and transportation conditions. A system for collecting origin and destination information on a continuing basis using more exact statistical methods being used in traffic-counting programs, and a better trained interviewing staff would provide more reliable data.

A continuous sampling survey appears to offer advantages in technique improvement and possible reductions in cost. To be successful the driving public must be convinced the studies are being conducted to determine where traffic is going, what improvements are necessary, and that they can be successfully developed only if each driver co-operates by taking time to answer the questions.

INTERNATIONAL NEWS

Hydro-Power Construction in the U.S.S.R.

Fyodor Loginov, Deputy Minister of Electric Stations of the U.S.S.R.

The creation of a power base for development of the country's national economy began in the very first years of the establishment of Soviet power in the U.S.S.R. In 1920, on the initiative of V. I. Lenin, the State Commission for the Electrification of Russia was set up to draw up a long-range plan for the development of the national economy on the basis of electrification (known as the GOELRO).

The GOELRO plan provided for the building, among others, of 10 big district hydroelectric stations. The first of them were built under extremely difficult conditions, when there was not enough machines, materials or qualified workers. Nevertheless, in the period of 1920 to 1927 the Volkhov Hydroelectric Station on the river of the same name, the Zemo-Avchala station on the Kura River, and the Kondopozha Station on the Suna were built.

The basic principles of Socialist electrification—extensive use of water resources and local fuels, concentration of capacities and creation of power grids, rational relocation of productive forces throughout the country — have been embodied in Soviet power development. In the First Five-Year Plan period (1928-1932) the V. I. Lenin hydroelectric station, biggest in Europe, was built on the Dnieper River. At this development mechanization was already widely applied in earth handling and concrete pouring.

During the prewar Five-Year Plan periods power development proceeded extremely rapidly in the country: the Nizhne-Svirskaya station near Leningrad, the Rioni station in Georgia, the Kanakar and Dzoraget plants in Armenia, the Niva and Tuloma stations in the North-West, the Komsomolskaya and Tavakskaya in Central Asia were built. With the launching of the Nizhne-Svirskaya development, the first 220 kilovolt high tension transmission line in the Soviet Union connecting the station with Leningrad went into operation. New power grids were created through a high-tension network connecting electric stations within many districts, such as Moscow, Leningrad, the Donets Basin, the Dnieper River Valley and the Urals districts. Later these grids began joining up into interdistrict power systems. The Donbas grid was joined with that of the Dnieper River area.

As a result of the successful implementation of the GOELRO plan and the building of power plants during the First and Second Five-Year Plan periods, by 1935 the Soviet Union had moved up to third place in the world in electric power production.

Soviet people did a big job in restoring the electric stations destroyed by the Germans during World War II. Parallel to this, construction of new hydro developments continued. The big Rybinsk hydrostation on the Volga was finished, the Chirchik-Bozsu cascade, the powerful Farkhad station on the Syr Darya, and other hydroelectric plants were built in Central Asia. Several stations went up in the Urals.

In postwar years hydropower construction in the U.S.S.R. has acquired new impetus. During the Fifth Five-Year Plan period (1951-1955) such big developments were commissioned as the Ust-Kamenogorsk, Tsymlyanskaya, Verkhne-Svirskaya, Mingechaur, Gyumush and Narva hydroelectric stations. The first sections of the Kama, Gorky, Knyazhegubskaya and others have begun generating current. The Kakhovka hydro development on the Dnieper was built and commissioned ahead of schedule. In these years construction began of the big Kuibyshev, Stalingrad, Irkutsk, Novosibirsk, and Bukhtarma stations. On the Angara river the mammoth Bratsk hydroelectric development is under construction.

New equipment is being produced for these projects. For the Kuibyshev and Stalingrad stations, for example, 105,000 kw. hydroturbines have been manufactured. The diameter of the turbine's wheel is 9.3 metres (30.5 ft.), and the installation's overall height is 28 metres (92 ft.). Most of the existing stations have gone over to automatic control, and on several remote control from a single dispatcher's post is effected.

During 1951-1955 the increase in electric power production was 79,000 million kwh., which is more than envisaged by the plan. The total amount of electricity generated by hydro stations increased from 12,700 million kwh. in 1950 to 23,200 million kwh. in 1955. During this latter year alone hydroelectric stations helped to save 20 million tons of coal.

Soviet industry has equipped its power projects with firstclass construction machinery. In a short time the necessary quantities of many types of earth handling machines were produced. At the Verkhne-Svirskaya, Narva, Gorky, and Kuibyshev stations continuous-production concrete plants were set up. By the beginning of 1955 there were 58 concrete plants in operation at hydroelectric developments with a daily output of over 68,000 cubic metres (89,000 cu. yd.).

The introduction of progressive methods of construction and assembly and the use of modern machinery have made it possible sharply to reduce time limits. At the Kuibyshev development up to 395,000 cu. m. of concrete per month was laid, the daily quantity at times exceeding 19, 000 cu. m. This is more than the world record which belonged up till then to American builders who had laid 15,700 cu. m. in 24 hours at the Grand Coulee project.

At the construction of the Gorky station a new method of concrete pouring was introduced in which 70-ton reinforced falsework panels were used. These panels, made of a reinforced frame with the falsework or a casing of ferro-concrete plates mounted on it, are prepared in advance at a special site, and the concrete can be poured as soon as they are assembled.

The damming of such big streams as the Irtysh, Kama, Volga, Dnieper, Angara, and Syr Darya from pontoon bridges has been mastered. At many developments the hydro-turbine installations were assembled in large sections which made it possible to reduce assembly time and commission the stations ahead of schedule.

Electrification will be developed further under the 1956-1960 plan. In this period hydro-power capacities are to grow by 170 per cent. Besides the central industrial areas of the country, hydro-stations will be built in Siberia and Kazakhstan, Uzbekistan and Georgia, Armenia and Azerbaijan, in Lithuania, Moldavia and the Karelian ASSR. The Volga-Kama cascade, six stations of which are already in operation, three are under construction, and four are being designed, will be finished. In 1957 the Kuibyshev hydroelectric station — largest in the world — was launched to full capacity. Construction of the still bigger Stalingrad station is continuing on a broad scale, as is work on the Dnieper cascade where the Kremenchug and Dnieprodzerzhinsk plants are going up.

A number of powerful stations are being erected in Siberia which possesses approximately 60 per cent of the country's hydro-resources. Building of the 3,600,000 kw. Bratsk station is proceeding apace. This is the second plant on the Angara; the first—the Irkutsk station—will reach its peak load this year. Work has begun on harnessing the mighty Siberian river Yenisey, where the 4,000,000 kw. Krasnoyarsk station, which will be the biggest in the world, is already going up.

In Kazakhstan and Central Asia the big Bukhtarma project and the Kairak-Kum station, commissioned in 1957, will be supplemented by the Golovnaya station on the Vakhsh River, the Uch-Kurgan station on the Naryn, and several others, construction of which will begin shortly.

Hydropower development is continuing in the Northern Caucasus and Transcaucasia. In the Sixth Five-Year Plan period the Sevan-Razdan cascade in Armenia will be completed as a whole. Four stations are already in operation, two are being built, and three are in blueprints. In Azerbaijan the Varvarinskaya station has been finished below the Mingechaur development. In Georgia three hydro-stations will be finished and one more started.

By 1960, electric power production by hydro-stations will reach 59,000 million kwh., 155 per cent more than in 1955.

Work is in progress to create a single power grid for the European part of the Soviet Union. The Kuibyshev and Stalingrad stations will be connected with the Central, South, and Urals grids with high-tension transmission lines of 400-500 kilovolts. A D.C. power transmission line with a voltage of 800 kv. will connect the Stalingrad station with the Donbas.

A single power grid will be created in Central Siberia joining the Irkutsk, Bratsk, Krasnoyarsk hydroelectric stations and the big fuel power stations. The Georgian, Azerbaijanian, and Armenian grids will also be linked up.

As a result of the consistent implementation of the plan for the electrification of the country, the Soviet Union has scored great successes in developing the power base for the national economy. In 40 years electric power production has grown more than 100-fold and reached 209,500 million kwh. in 1957, including 39,300 million kwh. of hydroelectric power.

GREAT BRITAIN

NEW "CHURCHILL" COLLEGE

A new college is to be built at Cambridge University and named after Sir Winston Churchill in recognition of his long-standing interest in provision of facilities for study of science and technology. An appeal has beeen launched for nearly 3½ million sterling to build and endow this college.

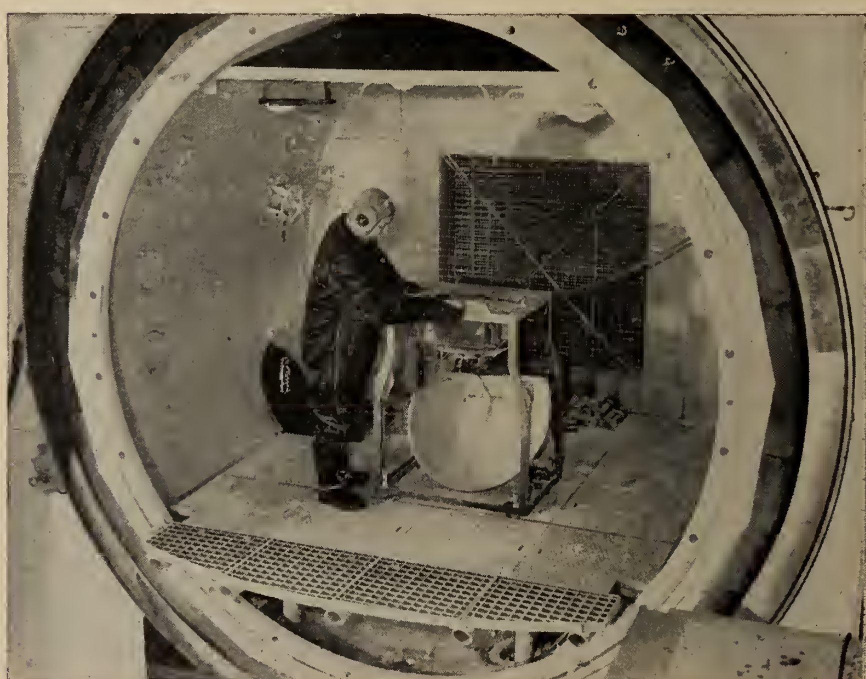
The aim of the men's college will be to help increase Britain's output of technologists, and under present plans at least seventy per cent of students will study scientific or technological subjects. The trustees also state that the college would also try to attract postgraduate students from foreign countries and the Commonwealth and to create a number of visiting fellowships for overseas specialists.

Sir Winston, who is one of the trustees, has offered to donate £25,000 from his birthday trust fund towards the cost of the college. An offer of £50,000 has come from the Calouste Gulbenkian Foundation in Lisbon as what Foundation authorities describe as a "willing tribute to the greatest living Englishman". The Gulbenkian grant will provide three studentships for graduates of universities outside the U.K.

While the appeal for funds is primarily directed to industrial, commercial, and financial circles, support is welcomed from institutions and individuals. Donations may be sent to Churchill College Trust Fund, at Cambridge.

STRATOSPHERE CHAMBER AT ROYAL RADAR ESTABLISHMENT

The Royal Radar Establishment, at Malvern, Worcestershire, is concerned with the development and testing of equipment for Britain's defence system. Extensive use is made of computers, simulators, and experimental test vehicles. The picture shows a radar scanner installed for testing in the Establishment's stratosphere chamber. In this chamber, temperature and humidity can be varied to simulate conditions in the Earth's atmosphere from sea level to an altitude of 100,000 feet. Equipment can be tested under extremes of temperature, pressure, humidity, vibration, and shock. Research is also carried out in a wide field of physics and electronics.



Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

St. Lawrence Seaway and Power Project

Progress by Ontario Hydro

Weather throughout the month of May was generally favourable for construction. The work force was increased slightly in May and a total of 2,750 persons was working on the Ontario Hydro half of the project.

Concrete placing on the Canadian half of the international power-house had reached an advanced stage on the deck at the end of May.

Meanwhile, removal of the steel cell cofferdam in the tailrace area in front of the power-house was progressing steadily on both sides of the international boundary. On the Canadian side, seven cells had been removed at month end. This will permit the tailrace water to be discharged when first power is produced in July.

In the power-house, work was started on assembling the rotor for unit seven. The stator winding was started on unit seven and was completed on unit five. Control wiring for the first four units was about 85 per cent finished. Assembling the transformer bank for units five to eight was progressing and work also was proceeding on the bus installation for these units. The 230-kv. cable circuit for the first four units was installed through the tunnel and technicians were busy hooking up the high voltage connections.

The first five turbines had been installed and rotation tests had been completed on units one and three. Forty-six headgates and 36 headgate hoists had been installed. The service piping had been fully installed for the first four units. Nine unit covers had been assembled. All three ice sluice drum gates were in position and tests were underway.

All eight sump pumps and dewatering pumps had been installed and were in service. On the tailrace side of the power-house, assembly of the 15-ton gantry crane was well advanced.

The necessary installations to take power from the generating station to the St. Lawrence transformer station and then into the Ontario Hydro system were more than 80 per cent completed. Work had started on the footings for the 115-kv. circuit from the transformer station to Kingston. Metering equipment was being installed in the control building at the transformer station and was about 95 per cent completed.

Progress by NYSPA

During May, concrete in place for all structures passed the two million cubic yard mark or 98 per cent of the estimated total. Excavation quantities had reached 50,600,000 cubic yards or 95 per cent of the estimated total. Employment averaged 3,470 for the month.

The American half of the power plant some 8,300 cubic yards of concrete was placed bringing the total to 98.5 per cent complete. Work preparatory to flooding the reservoir was nearing completion. Intake gates and hoists were being installed. Installation of the main grounding mat upstream of the power-house was started. Four of the generators were more than 95 per cent installed. The installation of telephone equipment in the power-house and switchyard service building was started. Erection of the elevated water tank was started.

At Long Sault dam, removal of the bridge and plug in Cut "C" was completed. Some 26,000 cubic yards of concrete was placed in sluiceways and pier noses. Approximately 96 per cent of the required concrete had been placed. Installation of electrical and mechanical equipment in the north bulkhead sections and the elevator continued.

Construction of the seaway power facilities was virtually completed, except for several miscellaneous items to be completed as material is received.

Progress by SLSDC

All excavation, concrete placing and gate installation on the two American locks had been completed by the end of May. The mainland section of the Long Sault canal had also been completed, though some excavation remained at downstream end of the Grass River (now "Snell") lock for the 27 ft. depth, which is not scheduled for completion until year-end.

Work continued on the Cornwall Island north channel. On the south channel all contracts will be completed to 14 ft. depth by July 1. The cofferdam had still to be removed.

The labour force had been reduced to some 400 persons.

Progress by SLSA

Vessels are now using the Iroquois lock. At the upper Beauharnois lock all concrete was to be poured by mid-June for the lock proper. Some concrete remained to be placed in the upstream and downstream approach walls. Trains are now using the New York Central bridge over the lock.

On the lower Beauharnois lock the lock walls were all poured by month's end. The entire structure, including upstream and downstream approach walls, was to be completed before end of June. Lock gate machinery installation was progressing.

At the Cote Ste. Catherine lock all concrete was placed with exception of part of the upstream approach wall. Piers were poured for the spillway to serve the Hydro-Quebec power development. Excavation was completed for the wharf near Cote Ste. Catherine and some 9,000 yards of concrete had been placed by the end of May.

At the St. Lambert lock, with gates and machinery all delivered, erection of mitre gates was nearing completion. Water had been let in on the stretch of channel between Jacques Cartier and Victoria bridges and on another two mile stretch from a short distance above Victoria bridge to Brosseau. Excavation of the channel from the Mercier bridge to Lake St. Louis had reached various stages of completion, and was reported to be on 'schedule'.

Dredging through Lake St. Louis was reported to have reached 90 per cent of completion at end of May, while at the upstream approach to the Beauharnois canal dredging in Lake St. Francis was some 55 per cent done.

Bridges: Jacking of the superstructure on the south half of the Jacques Cartier bridge had reached full height excepting at piers 7 to 11 inclusive. On the Victoria bridge, with lift spans in raised position, the lift machinery was being installed on the towers. A start had been made assembling structural steel on the ground for the lift spans on the diversion over the upstream end of St. Lambert lock.

On the Mercier Highway bridge, with steel erection complete, the concrete deck had all been poured between the remaining part of the old bridge and the south abutment. Steel for the span across the seaway channel was 100 per cent erected and 90 per cent riveted, though the deck had not been poured.

All steel erection was complete at end of May on the Caughnawaga rail bridge and painting was under way. Rail traffic was diverted over the new east or downstream span on June 5.

Employment during May averaged some 5,700 persons.

Tenders for the new Nun's Island Bridge between Verdun and the South Shore were to close June 19, according to the National Harbours Board. Target date for completion is late 1961 or early 1962. Construction will be in three stages; the span to Nun's Island; the level roadway across the island; and the third and longest section from the island to the South Shore. Total length will be almost four miles from end to end.

Canadian Pipeline Projects

Alberta Gas Trunk Line

Work commenced on May 1 on the Company's main line system and on the north lateral. Work includes 49 miles of 34-inch main from Princess to Cavendish, 24 miles of 26-inch lateral from Cessford to Princess and 6600 feet of 18-inch line in the Cessford field. A $1½ million contract was awarded to Fulton Bannister Ltd. Including materials and construction the 74 miles will cost some $9 million. Completion is planned for August 31. A major crossing of the Red Deer River is already completed. Some 250 men will be employed.

Trans Canada Pipelines

Some 4,500 men are working this year in the field building the final 853-mile link of the Trans-Canada natural gas pipe line from Alberta to

Eastern Canada. Completion of the line is scheduled for the fall of 1958. Constructors worked through severe winter conditions on the 853-mile section of 30-inch pipe line from Port Arthur to be completed this year. A total of 510 miles of right-of-way already have beeen cleared, 140 miles have been graded and pipe has been received, strung or stock-piled along the route for over 800 miles of line.

Twelve pipe line construction crews are preparing for all-out operations as soon as weather and terrain conditions permit. Five of the contractors will be working on the 367 miles of line from Port Arthur to Kapuskasing, being built by the Northern Ontario Pipe Line Crown Corporation, with construction under supervision of Trans-Canada, and seven of the contractors will be working on Trans-Canada's section, 486 miles from Kapuskasing to Toronto.

In addition to the actual pipe line construction, six compressor stations will be built, with a total of 48,500 horsepower, an increase of 20,800 horsepower over what was originally planned for this year. The compressor stations will be built at Burstall, Caron, Moosomin, in Saskatchewan; Winnipeg, Manitoba; Port Arthur and North Bay, Ontario.

By end of 1957 a total of some 1,360 miles of pipe line had been constructed and placed in operation, including 586 miles of 34-inch line from Alberta to Winnipeg; 395 miles of 30-inch line from Winnipeg to Port Arthur, and 379 miles of 24-inch, 20-inch and 12-inch line from Toronto to Montreal and including the Ottawa extension.

Since the fall of 1957 Trans-Canada has been supplying natural gas to customers from Saskatchewan to Port Arthur and along the eastern section of the line between Toronto and Montreal. To enable building of distribution system and building of load in Montreal and points between Toronto and Montreal a year before the arrival of Alberta gas, arrangements were made to borrow gas for this section from Union Gas Company of Canada Limited.

Work on the five main line spreads from Lakehead to Kapuskasing opened up late in May. Some contractors had already moved in equipment but frost in the ground had retarded ditching. The major river crossings of the Nipigon, Kenogami and Missinabi rivers had been awarded to Pentzien (Canada) Ltd., of Toronto. Awards of contracts for the five spreads west of Kapuskasing by Northern Ontario Pipeline Crown Corporation were reported in the February issue.

Saskatchewan Power Corporation

Contracts have been awarded by SPC for laterals and local distribution systems comprising the entire 1958 program of local extensions. The largest jobs at Weyburn and Estevan were awarded to Banister-Helm Ltd. at $800,000. The Maple Creek lateral and distribution system went to Robb Construction Company for $200,000. The Lampman distribution system was awarded to Shamrock Construction Company. Further contracts totalling $365,000 were awarded for smaller jobs.

Northern Ontario Natural Gas

Construction of laterals and distribution systems in northern and northwestern Ontario franchise areas was ahead of schedule for 1958, according to a report issued in mid-May, and projects for 1958 should be completed by September. Almost $3 million will be spent for completion of laterals outlets and distribution lines started in 1957. New projects involving 2,920,000 ft. of short laterals, industrial takeoffs, local systems and two major laterals will cost $18.7 million.

Contracts for laterals and distribution systems in Orillia, Bracebridge, Gravenhurst and Huntsville have been awarded to Triton Constructors Ltd.

for scheduled completion in November.

Additional large industrial gas sales have been signed up, making up nearly one third of the company's total expected industrial demand.

International Nickel takes 6 million c.f.d. at Sudbury, while Great Lakes Paper Co. will take up to 16 million c.f.d. at Fort William. The Company has negotiated a new contract with Trans Canada under a 90 per cent load factor, compared with a former 75 per cent load factor. This will result in a saving of 2 cents per 1000 cubic feet. The Minnesota and Ontario Paper mill at Kenora will be the first such plant in Northwestern Ontario to be served by the company and its affiliate, Twin City Gas under contracts totalling 67 million c.f.d.

Union Gas Company

The Company's 142-mile main pipeline across southwestern Ontario was completed last December and is now being operated by Ontario Gas Storage and Pipelines Ltd., a wholly owned subsidiary. The Company's expansion program will continue during 1958. Union acquired the major portion of Dominion Natural Gas Company's facilities in April and will extend its facilities to existing markets and new communities. Transmission lines will be built from the Windsor area to Amherstburg, from the Stratford area to Goderich and from the 26-inch main pipeline to St. Marys. For fiscal year ending March 31 the company reported an 11 per cent increase in net earnings, and a new record high volume of gas sales of some 17.5 billion cubic feet.

Free Piston Gasefier

A. Braun of the Mechanical Engineering Department at Queen's University has designed a free piston gasefier. The Free Piston Development Co. Ltd. has been incorporated, a prototype engine built and successfully operated to prove the design.

The design is not based on Muntz or Pescara patents. It is an *outward* compression type, Mr. Braun's design incorporating features that make it even more simple and compact than the conventional inward compression units, it is reported. It can therefore be considered a major advancement in the engine field.

Queen's University is underwriting the patents and part of the development costs. The prototype has Mechanite pistons (to keep the speed down until injection timing, cooling, lubrication, etc., are thoroughly tested and properly regulated). It is designed to develop 42½ gas horsepower at 2,100 cycles per minute and weighs 180 lb. It is calculated that light alloy pistons will step the speed up to 3,300 cycles per minute and the power to 66½ gas horsepower and that the production unit weight need not exceed 130 lb. Larger sized units will not involve nearly as severe design problems.

This type of gasefier should have applications for marine, automotive, tractor and locomotive power.

What Goes On

Iron Ore Activity

Quebec Cartier Mining Company recently invited bids to build a 193,-mile railroad alongside the access road from Port Cartier to Lac Jeannine and also to construct a 60,000 horsepower hydro electric plant on the Hart-Jaune River, a tributary of the Manicouagan River, a few miles south of the Company's main mining area in the Mount Reed-Mount Wright region.

It is anticipated, the Company reports, that bids for other portions of the project will be invited as engineering designs are completed. These will include a deep-draft harbour and loading facilities at Port Cartier near Shelter Bay, the preparation of a large open pit mine, and construction of a concentration mill capable of producing 8 million tons of high grade concentrates per year. These installations will also require the founding of two new towns to accommodate about 5,000 people.

International Nickel Report

Continuing favourable results in the exploration program at the Thompson Mine in Manitoba, have led the International Nickel Company of Canada, Limited, to the decision to concentrate their efforts on bringing this property into production. Dr. John F. Thompson, chairman of the board of International Nickel reported this to the annual meeting of the company in April.

The company's expansion in Manitoba and Ontario will increase its annual nickel production capacity to 385 million pounds by 1961.

The year 1958 marks the fortieth anniversary of the beginning of operations at International Nickel's refinery at Port Colborne, Ont.

Engineering and Physics Building, Mount Allison

Mount Allison University

Mount Allison University, Sackville, N.B., by means of new facilities, will be able to accommodate up to 350 engineering students, an increase of about 100.

The University gives three years of engineering. No major changes have taken place in the curriculum, it is reported. Mount Allison does, from time to time, adjust the course to meet the requirements of the universities with which it is affiliated, such as McGill University, Nova Scotia Technical College, and the University of New Brunswick.

A general expansion of the University is proposed, which would supply in the future an addition to the library, a home economics and geology building, additional residences, a new gymnasium and a new arts building, and a chapel.

The Engineering Department moved into a new Engineering and Physics Building at the beginning of 1958. This is a three-storey building, containing 30,000 sq. ft., 365,000 cu. ft., and located at College and York Streets.

The building provides, on the first floor, an auditorium, three lecture rooms, faculty laboratories, offices, library and reading room, storage for surveying instruments, etc. The second floor accommodates first and second year and advanced physics laboratories, electrical laboratory, stockrooms, optical laboratory, dark room, museum, computing room.

The third floor, given over entirely to engineering, has two large draughting rooms, lecture room, offices, faculty draughting rooms, blueprint and model rooms, and general utility room.

The building for Geology and Home Economics will affect engineering to the extent of providing suitable facilities for the geology courses. Construction of this building began this summer. Construction of the library addition and of three residence units will begin about the first of August.

Some new equipment is being purchased. This is largely additions to standard equipment, required to meet the demands of the increased enrolment in engineering.

Ontario Agricultural College

The Ontario Agricultural College at Guelph, Ont., is affiliated with the University of Toronto for academic purposes. The program in engineering is designed primarily for educating engineers and others for employment

The *Journal* Reports Growth in Engineering Faculties in Canada

Seventh article of a series

Engineering Building, Ontario Agricultural College

in agricultural and associated industries. It consists of a terminal B.S.A. (bachelor of science in agriculture) degree course, and two others which are co-ordinated with the School of Applied Science and Engineering, University of Toronto. In these, students take the first four years at Guelph and then complete the fifth year at the University of Toronto in mechanical engineering or civil engineering. The students in these two courses receive both the B.S.A. degree and the B.A.Sc. degree.

Although the mechanical engineering program has been in operation for three years, the past season was the first year for the civil program.

With the development of a Service Building on the campus, the Engineering Building was utilized almost entirely for teaching and research this year. The gymnasium, adjacent to the engineering building, was also used to expand the engineering program in teaching and research. This has permitted an expansion of the hydraulics laboratory, draughting laboratories, materials testing, and heat engineering laboratories.

This year additional materials testing equipment, cement and concrete equipment, and photogrammetry equipment, together with a fully instrumented laboratory type gas turbine heat engine, have been added to the laboratories. An R.C.A. electronic trainer and other special electrical equipment have been added to the electrical engineering laboratory for the expanded program.

There is considerable physical plant expansion going on at the College, with the completion early this year of a new Soils Building and an extensive Physical Education Building. Scheduled for start of construction this year is a new Biology Building, with a new Chemistry and Bacteriology Building scheduled for next year. This will permit considerable expansion in student body in all phases of the present teaching and research responsibilities of the College.

The Curriculum

A number of courses in civil engineering, including advanced structural design, cement and concrete, photogrammetry, astronomy, construction surveying, have been added for the new civil engineering program. The engineering library has been expanded extensively to include all recognized professional engineering journals and new reference engineering text books and microfilm equipment.

In preparation for next year's program, a major change in the curriculum is being undertaken. This will result in an opportunity for more mathematics, more time on engineering sciences and more time on humanities.

Secondary School Science

Ten Canadian secondary school teachers of science and mathematics from Nova Scotia to British Columbia have been named by Cornell and Stanford Universities to receive 1958 Shell Merit Fellowships. The Fellowships provide special leadership training.

Throughout the 6-8 week seminars, the Fellows will participate in courses, special lectures, discussions, visits to research and production establishments.

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

Report to the Members*

by

C. M. Anson, M.E.I.C.
Sydney, Nova Scotia

THE PAST YEAR has been the most interesting and most enjoyable year of my life. As your president, I have been privileged to journey throughout this great country of ours, to visit other countries as your representative. I have been particularly fortunate in that my wife was not only able, but at all times more than willing, to share with me the so-called hardships of travel.

During the 12 months starting with the trip to Banff a year ago, I have travelled over 70,000 miles, by ship, train, airplane and car. To emphasize the variety, the boys at Trail even had me travel some distance by ski lift. We have visited 36 of the 50 branches of the Institute. By so doing the presidential office has been made available to over 15,000 of the 18,000 members. I regret that time did not permit a visit to all branches and to the members of those branches I did not visit I herewith tender my sincere apologies and regrets.

Of particular interest is that I have been privileged to take part in the inauguration of three new branches of the Institute, one of the many indications of the healthy condition of the Institute. One of those branches, that at Sept Isles, is helping to push back the physical boundaries of Canada, another at Baie Comeau involved in extending Canada's industrial empire, and the third at Chalk River, specifically concerned with pushing back the frontiers of knowledge, not only for the benefit of Canada, but for all mankind. These and many other worthwhile projects, from one end of our country to the other, have been planned by, are being erected and operated by engineers, members of the Institute, engineers who are anxious to take part in Institute affairs. Such men desire the facilities which permit them to advance their own technical knowledge, to discuss their own and the problems of others with fellow engineers, the opportunity to tell by means of technical papers of the interesting features of jobs performed by them or under their direction, to listen to papers from other engineers. It is gratifying to be able to report that the demand among engineers across Canada for such facilities is keen and widespread. Only so long as our profession continues to regard such matters as of vital necessity to them, in fact to consider such services to themselves and to their fellow engineers as of prime importance, will the interests of our profession be further advanced, will the community at large continue to regard the profession with the respect with which it is regarded today.

I bring this subject to your specific attention, because I am disturbed about an attitude I have found in some quarters, again rather generally across the country. As I interpret my impressions, there seems to be a feeling that any body representing engineers should be primarily concerned with the advancement of the engineer as an individual; that it should concern itself principally with registration, wage scales, pensions, insurance schemes and such other matters as affect the personal welfare of the individual. Now let me state quite emphatically that I support to the utmost what is to me a basic principle, that the engineer who does good work should be well paid, that he is deserving of a pension system, preferably a contributory one, that there should be some system devised which will protect him from disaster arising from unexpectedly heavy medical expense. But, if the day should come when the engineer depends upon registration and suchlike to perpetuate the profession, upon security emanating from his own desire and ambition, then I say to you, as from that date onwards the profession will retrogress.

From being the proud upholders of a professional tradition of well-merited standing, we shall deteriorate to a lower status of being, hewers of wood and drawers of water for those with more venturesome spirit. Our profession needs to perpetuate and foster that spirit of individuality which up to this time has been a hallmark of it. I recently heard John Fisher plead for more of the I's and We's and less of the Me's and They's. Unless we get an affirmative response to that plea we shall degenerate into a profession that will deserve just what is handed out to it and nothing more.

Institute, an Influential Factor

Apart from that disturbing feature, I can report to you that your Institute is in a particularly healthy condition. Never before in Canada's history has the profession been so highly regarded. Your Institute has had no inconsiderable part in bringing about that condition. It is no mere coincidence or accident that all recent appointments to the Canadian membership of the International Joint Commission have come from the ranks of engineers. Only a few years ago all such appoint-

*This address was delivered before the 1958 annual general meeting of the Engineering Institute of Canada, at Quebec City, Que., May 21, 1958.

ments were of a political character. Direct representations by your Institute have been an influential factor in bringing about this desirable change. I could go on for hours instancing improvements to the profession that have been similarly brought about. Favourable response to our representations have come about only because we have been a society above reproach, a society interested primarily in the advancement of our profession to serve humanity, a society against which no one could level even the slightest charge of individual gain. Let us keep it that way.

Leadership in Education

We must continue our program of leadership in the field of engineering education. Few people realize that in Canada the Institute has done more in that field during the past three years than has been done by all other agencies together. By our sponsorship and financing of the meetings of deans of engineering schools, our students' conferences, our faculty advisors, our prizes, our Bennet Fund, we are playing a leading roll in the search for more and better engineers. It is of interest to note that during 1957-58 we have had 1,500 applications from students for membership.

With increasing frequency our members are being asked for advice in respect to matters of education, to serve on boards of governors of universities, on committees having to do with the establishment of courses at new engineering schools, or with changes to existing courses.

Our interest and participation in educational matters, is not confined to learned institutions. The branches have continued and expanded Professional Development Courses. At this point may I pay a well-merited tribute to Past-President Col. Leroy Grant, who was responsible for the inauguration of this phase of Institute work. These courses are being given by more and more branches to increasing numbers of not only members of the Institute but to others who are taking advantage of their availability. The Calgary Branch is a splendid example of what is being accomplished. During the past winter, some 350 people were enrolled in the courses organized by that Branch.

We are sponsoring an exhibit, presently circulating the Branches, entitled "Atoms for Peace in the U.S.S.R." The exhibit depicts in some 60 montages, what is being accomplished, in Russia, in the fields of agriculture, medicine, industry and so on, by the release of energy from the breaking down of the atom. We hope that as many Canadians as possible will arrange to see this exhibit. Canadians can be justifiably proud of what its scientists and engineers have accomplished in this same field, indeed could present an exhibit from which the whole world could learn. By seeing what is being accomplished elsewhere, our people will be alerted to the need for continued research and development in the atomic energy field, and the work of our own people in that field will be facilitated and advanced.

Having witnessed for many years the success of the regional meeting sponsored jointly by the Maritime Professional Associations and the Institute as represented by its branches in those provinces, and in furtherance of the evident need for more opportunities for engineers to foregather, the Hamilton Branch held the first such regional meeting in that area this year. It was an unqualified success, admirably organized by the Hamilton Branch. A registration of some 700 people indicates the need for further meetings of that character.

The *Journal* is one of the barometers indicating the state of the health of your Institute. All will agree with me as to the improvements that have brought the *Journal* up to what it is today, and join me in complimenting those responsible for its publication. With a monthly circulation of over 19,000, averaging in excess of 200 pages per issue, carrying articles and news of interest to the profession, it occupies a most prominent part in the publication field.

This year we have resumed publication of *Transactions*, an important service to the profession. Through it we expect to further that aim of the Institute having to do with the dissemination of knowledge among members of the profession. It will fill the need for means of publication of papers by members and others, papers usually of very high standards, but whose subject matter is such as to preclude publication in the *Journal*.

In furtherance of the policy of focusing favourable public attention on the profession, we have published the first of what we hope will become a library of biographies of prominent Canadian engineers. "Daylight Through the Mountain" has been well received, and is a credit to the profession and to the Institute. We are indebted to its author, Dr. Walker.

The Cambie Memorial plaque was unveiled in its permanent place in the Canadian Pacific Railway station in Vancouver, in the presence of a most distinguished gathering, which included a son and two daughters of Henry John Cambie.

We have published, for the first time, "Engineering Careers in Canada". Its distribution among students has been remarkably well received. Its purpose is to attract students to engineering by letting them know of the different branches of engineering open to them and what employers expect of engineers in the respective fields.

No report would be complete, at this particular time without some mention of confederation. To the Branch officers, and whenever the opportunity has offered, to the members of every Branch I have visited, I have talked on the subject. There exists without question, a widespread desire for confederation. Your Council and officers, both elected and appointed, and the Committee appointed by Council to deal with this matter have, and are, in every respect diligently following out the wishes of the membership towards that end. A report from the two committees representing the Canadian Council of Associations of Professional Engineers and your Institute is presently before Council.

Thanks to good management and an alert Finance Committee the financial position of your Institute was never better.

Finally, I would like to make a few observations arising out of my impressions from branch visits.

It is quite evident that closer liaison between branches and between branches and headquarters is needed. As between branches, the extension to other districts of regional meetings such as those held in the Maritimes and the one in Hamilton this year, would bring the branches closer together. Occasional interbranch visits by specifically organized groups could help. Continuation and extension of Regional Council Meetings will similarly promote interbranch communications.

For some time past it has been recognized that communication between branches and headquarters is inadequate. This condition has been improved by the appointment of field secretaries in the East and the West.

The regional meeting of councillors, held in Edmonton in March, is a move in the right direction.

The occasion of the president's visit to branches is, however, the only occasion which offers opportunities for full and frank discussion between representatives from Headquarters and branch officers, and in some cases

(Continued on page 144)

MARITIME PROFESSIONAL ENGINEERS CONFERENCE

September 2 - 5, 1958
Digby Pines, Digby, N. S.

Sponsored by the Branches of the Engineering Institute of Canada in the Atlantic Provinces and the Associations of Professional Engineers of Newfoundland, New Brunswick, Prince Edward Island and Nova Scotia.

Program

Tuesday, September 2.

4.00 p.m. - 9.00 p.m. Registration.

9.00 p.m. - 10.30 p.m. Operation "Nite Cap".

Wednesday, September 3.

8.00 a.m. Operation "Eye Opener".

8.15 a.m. Early Bird Breakfast.

10.00 a.m. Professional Sessions
CANADA'S PROGRESS TOWARD ECONOMIC NUCLEAR POWER, by J. L. Olsen, manager, product planning, civilian atomic power department, Canadian General Electric company, and
THE SHIPPEGAN ISLAND AND CAMPBELLTON BRIDGES, by Dr. T. A. Monti, consultant engineer, Montreal.

11.00 a.m. Ladies' Sherry Party.

12.01 p.m. Maripenco Room.

1.00 p.m. Luncheon.

2.30 p.m. Golf Tournament for men.

3.00 p.m. Ladies: bridge, putting, or shuffleboard.

6.30 p.m. Maripenco Room.

7.30 p.m. Dinner.
ADDRESS by the Honourable R. A. Donahue, Q.C., Attorney General, Nova Scotia.

10.00 p.m. Informal Thrash, featuring "The Continentals".

Thursday, September 4.

10.00 a.m. Professional Sessions,
SUBJECT TO BE ANNOUNCED, J. C. Floyd, vice-president in charge engineering, Avro Aircraft.
INDUSTRIAL APPLICATION OF COMPUTERS, by a member of Computing Devices of Canada.

10.30 a.m. Ladies Shopping Trip to Digby.

12.02 p.m. Maripenco Room.

1.00 p.m. Luncheon.
"OLD INNS OF ENGLAND," an address by J. C. Richardson, Northern Electric Company Limited, Montreal.

3.00 p.m. Don't Miss It.

6.30 p.m. More Maripenco.

7.30 p.m. Dinner.
ADDRESS To be announced.

10.00 p.m. Closing dance, featuring "Don Warner and His Orchestra".

√ HOTEL. All meetings, functions, at The Pines. Rate: $13.00 per day, double, $15.00 per day, single, including meals. All rooms, twin beds and bath. If number persons attending exceeds capacity of hotel, arrangements will be made for outside accommodation. Rates, details, available at registration desk. For further details write: W. T. Windler, chairman, registration committee, Maritime Professional Engineers' Conference, Box 460, Halifax, N.S.

√ DRESS. Informal at all functions.

√ LADIES. Ladies may attend all sessions, technical and other. Special entertainment arranged by Ladies' Committee.

√ FEES. Registration. $7.00 for members, $3.00 for ladies. Includes all costs, including gratuities. Does not cover cost of golf, swimming pool fees, or hotel.

√ TRANSPORTATION. Delegates planning to cross the Bay of Fundy from Saint John to Digby on S.S. Princess Helene should arrange immediate reservations with C.P.R.

Fiftieth Branch Inaugurated

A real milestone was reached when president Anson inaugurated at Chalk River the fiftieth branch of the Institute.

The president and Mrs. Anson, accompanied by the general secretary and Mrs. Wright, were present and the Ottawa Branch was well represented by Hector Chaput, the chairman, and M. V. Morris, the secretary. Ottawa presented a substantial cheque to aid the new branch in its first endeavours. The inauguration of the branch took the form of a dinner followed by a business meeting.

The meeting was opened by C. A. Crawford who was provisional chairman, but who during the course of the evening was elected to the chairmanship of the branch for the year. Also he was appointed councillor to attend the annual meeting of Council to be held in Quebec City.

Lorne Gray, M.E.I.C., newly elected president of Atomic Energy of Canada Limited, was a head table guest.

The balance of the officers elected at that meeting are as follows: J. G. Melvin, C. E. L. Hunt, J. S. Flavelle, and secretary, W. O. Findlay.

The branch has a great potential as far as activities and membership are concerned. It is expected that it will provide an outlet for many engineers around the plant who previously have not had a technical organization to which they could direct their activities.

All in all the occasion was a bright and pleasant one. The president was the official speaker but later the meeting was turned over to questions and observations from the floor. This carried on to a late hour. There was a festive air about the whole gathering, not only because the branch had become an asset to the community but because its inauguration marked a great period in the life of the Institute.

The Institute now starts out on the second half of its first hundred branches.

Did You Know That...

As a member of The Engineering Institute of Canada, you can get the periodical publications of Sister Societies at reduced rates.

Minutes of the 72nd Annual General Meeting

The seventy-second annual meeting of The Engineering Institute of Canada was convened in the Ball Room of the Chateau Frontenac, Quebec City, on Wednesday, May 21, 1958, at ten o'clock a.m. with President C. M. Anson in the chair.

The minutes of the seventy-first annual general meeting as published on pages 1154, 1156 and 1157 of the August 1957 *Journal* were taken as read and approved.

Nominating Committee

The membership of the Nominating Committee of the Institute for the year 1958 is as follows:

Chairman: Frank R. Pope, Peterborough.
Amherst, O. M. Sweetser.
Baie Comeau, Charles Miller.
Belleville, T. J. McQuaid.
Border Cities, C. G. R. Armstrong.
Brockville, J. G. Kerfoot.
Calgary, H. R. Hayes.
Cape Breton, C. N. Murray.
Central British Columbia, H. D. DeBeck.
Corner Brook, T. P. Pumphrey.
Cornwall, G. B. Stidwell.
Eastern Townships, Georges P. Cote.
Edmonton, H. L. Roblin.
Fredericton, H. W. McFarlane.
Halifax, G. Frank Bennett.
Hamilton, L. C. Sentance.
Huronia, S. R. Walkinshaw.
Kingston, D. I. Ourom.
Kitchener, M. A. Montgomery.
Kootenay, T. W. Lazenby.
Lakehead, G. S. Halter.
Lethbridge, C. S. Clendening.
London, Howard L. Hayman.
Lower St. Lawrence, Jean R. Menard.
Moncton, H. S. McCleave.
Montreal, H. Gaudefroy.
Newfoundland, C. A. Knight.
Niagara Peninsula, C. G. Cline.
Nipissing and Upper Ottawa, T. C. MacNabb.
North Eastern Ontario, T. M. Devine.
Northern N.B., V. G. MacWilliam.
North N.S., R. S. Morrow.
North Shore Lower St. Lawrence, Mel Storrier.
Ottawa, R. E. Hayes.
Peterborough, Barry Ottewell.
Port Hope, W. S. Raynor.
Prince Edward Island, H. R. Miller.
Quebec, Gilles Sarault.
Saguenay, F. H. Duffy.
Saint John, F. L. Doty.
St. Maurice Valley, E. R. McMullen.
Sarnia, S. V. Antenbring.
Saskatchewan, Wm. R. Staples.
Sault Ste. Marie, F. H. McKay.
Sudbury, P. E. Semler.
Toronto, W. H. Paterson.
Vancouver, S. S. Lefeaux.
Vancouver Is., T. A. J. Leach.
Winnipeg, T. E. Storey.
Yukon, J. R. B. Jones.

Honorary Memberships

The general secretary reported that the following had been elected to honorary membership in the Institute and that certificates would be presented at the luncheon on Friday, May 23rd.

Armand Charles Crepeau, D.S. (Hon.), Dean of the Faculty of Science, University of Sherbrooke, Sherbrooke, Que.

Sir Claude Dixon Gibb, C.B.E., F.R.S., D.Sc., M.E., Chairman and Managing Director, C. A. Parsons & Co. Ltd., Newcastle-upon-Tyne, England.

Philip Louis Pratley, B.Sc., B.Eng., M.Eng., D.Eng., Structural Engineer, Montreal, Que.

Irving Richard Tait, B.Sc., D.Sc., formerly Chief Engineer, Canadian Industries Limited, Montreal, Quebec.

Earle Oliver Turner, B.Sc., D.Sc., formerly Dean of Engineering, University of New Brunswick, Fredericton, N.B.

Leslie Austin Wright, B.A.Sc., D.Eng., General Secretary, The Engineering Institute of Canada, Montreal, Que.

Awards of Medals and Prizes

The general secretary announced the awards of various Institute prizes as follows stating that the formal presentation would be made at the luncheon on Friday, May 23rd.

On behalf of all the members of the Institute the president congratulated the winners whose names had just been presented.

Julian C. Smith Medals—"For achievement in the development of Canada", to Richard Edgar Heartz, B.Sc., LL.D., M.E.I.C., President and Director, The Shawinigan Engineering Company Limited, Montreal, Que. and Robert Edwards Jamieson, B.Sc., M.Sc., O.B.E., M.E.I.C., formerly Dean of Engineering, McGill University, Montreal, Que.

Robert W. Angus Medal—"For the best paper on a Mechanical Engineering Subject", to Russell J. Kennedy, M.E.I.C., Assistant Professor, Queen's University, Kingston, Ontario, for his paper, "Forces Involved in Pulpwood Holding Grounds".

Duggan Medal and Prize—"For papers dealing with the use of metals for structural and mechanical purposes", to Robert David, M.E.I.C., District Engineer,

(Continued on page 142)

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Dr. I. F. Morrison, retired professor of the faculty of engineering, University of Alberta, who for thirty-five years, commencing with the first graduating class, taught every engineering graduate at the University of Alberta, died at Edmonton on February 27, 1958. He was active in his professional interests to within a few hours of his death.

Born at Braintree, Massachusetts, U.S.A., in 1889, Ibrahim Follansbee Morrison was educated at Boston and studied engineering at the Massachusetts Institute of Technology. In 1911 he was awarded a B.Sc. degree in civil engineering.

Appointed a lecturer in civil engineering on the staff of the University of Alberta in 1912, he became a professor of applied mechanics in the department of civil engineering in 1922. He continued in this position until his retirement from university life in 1954.

During the course of his career he served in World War I in the United States army as an infantryman, and machine gun instructor. He was sent overseas in 1918 where he served in France.

During his academic career he was active in research and in professional practice in his special field of competance.

In recognition of his teaching and professional contributions to the welfare of the province, he was awarded the degree of Doctor of Laws, honoris causa, by the University of Alberta, at the fall convention in 1953.

Lt. Col. George Addie, M.E.I.C., retired soldier, consulting civil engineer and land surveyor died at Quebec City, Que., on May 15, at the age of 89.

George Kyle Addie was born at Sherbrooke, Que., on June 16, 1868. He attended Sherbrooke Academy, Bishops College School, and the Seminaire Nicolet for his general education. In 1889 he graduated from McGill University with a B.Sc. degree and qualified as a Quebec Land Surveyor a short time later. In that year also, he opened a private consulting practice which he carried on until recently.

George Addie joined the 53rd (Sherbrooke) Regiment as a second lieutenant in 1890. He attended the Royal School of Infantry in 1891 at St. Johns, Que., and was soon promoted to the rank of captain and quartermaster. In 1903 he transferred to The Corps of Guides with the rank of major. Moving from Sherbrooke to Quebec in 1906 he was promoted to the rank of lieutenant colonel, and took over the post of divisional intelligence officer, for Military District No. 5. He retired from active service in 1912, receiving the long service decoration. In 1914 on the outbreak of World War I, Lt. Col. Addie returned to active service. He was responsible for the formation of Valcartier Camp and was later assistant transport officer.

Lt. Col. Addie joined the E.I.C. as a Student Member in 1887, transferred to Associate Member in 1898, and to Member in 1935. He attained Life Membership in 1938.

E. V. Gage, M.E.I.C.

Herbert O. Keay, M.E.I.C., retired manager of the research laboratory, Consolidated Paper Corporation Limited, Three Rivers, Que., died at Sudbury, Ont., on May 14, 1958.

Born at Laconia, New Hampshire, U.S.A., on August 15, 1875, he attended the Massachusetts Institute of Technology and graduated with a B.Sc. degree in mechanical engineering in 1900. He served a special apprenticeship during the summer vacations in Boston and Maine, with the Nicholson File Company and the railroad shops. He was an assistant plant engineer with the Pennsylvania Steel Company, Steelton, Pa., from 1900-1902, chief draftsman, motive power department, Boston and Maine railway and later mechanical engineer from 1902 to 1906. Named assistant professor of mechanical engineering at McGill University, Montreal, from 1906, this was followed by the appointment as professor of railway mechanical engineering and transportation in 1908. He retained this office until 1917. Mr. Keay became a consulting engineer with the Laurentide Company Limited in 1913. Three years later he took over the post of manager of the research department, retaining the appointment until 1928. At that time he undertook the responsibility of director of research, Canada Power and Paper Corporation. In 1931 he transferred his services to the firm with which he was associated at the time of his death.

He was an honorary life member, and past chairman of the technical section of the Canadian Pulp and Paper Association.

Mr. Keay joined the Institute as a Member in 1909. He attained Life Membership in 1947.

Dr. Benjamin Franklin C. Haanel, M.E.I.C., former chief of the fuels division of the department of mines and technical surveys, died in Ottawa on April 24, 1958.

Dr. Haanel was born at Cobourg, Ont., on September 2, 1877. He followed studies proceeding to the B.Sc. degree at Syracuse University, graduating in 1899. This was followed by a two-year period of special engineering at the Massachusetts Institute of Technology. Later he worked for the American Bridge Company, New York, the United Engineering and Contracting Company and other structural engineering compaies. In 1905 he moved to Ottawa to accept an appointment with the Department of the Interior and in 1910 was appointed chief of the fuels division, mines branch.

He was awarded the Gzowski Medal of the E.I.C. for a paper written in 1918 on "The Fuels of Canada."

In 1954 Dalhousie University conferred on him an honorary Doctor of Laws degree. Dr. Haanel was a Life Member of the American Institute of Chemical Engineers. He was a member of the Dominion Fuel Board; a member and secretary of the joint peat committee of the Dominion and Ontario governments.

Dr. Haanel joined the Institute as a Member in 1918. He attained Life Membership in 1942.

E. V. Gage, M.E.I.C., president of Byers Construction Company Ltd., and national vice-president of the Canadian Construction Association, 1957-58, died at Montreal on April 27, 1958.

Edward Victor Gage was born at Pearcetown, Que., on November 21, 1893. He received his engineering education at McGill University and graduated in civil engineering with the degree of B.Sc. in 1915.

He joined the firm of A. F. Byers Construction Company Limited later that year and remained with it throughout his lifetime. In 1942 he asumed the presidency of the organization.

In his work with the Canadian Construction Association Mr. Gage was first appointed to the C.C.A. management committee in 1944. He headed up the general contractors' section and had served four terms as chairman of the Standard Practices Committee before becoming national vice-president in January 1957.

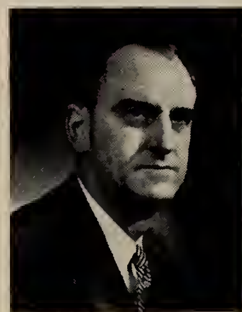
Mr. Gage was active in the affairs of the E.I.C. for a great many years.

Mr. Gage joined the Engineering Institute in 1914 as a Student; transferred to Associate Member in 1919; to Member in 1940. He became a Life Member of the organization in 1955.

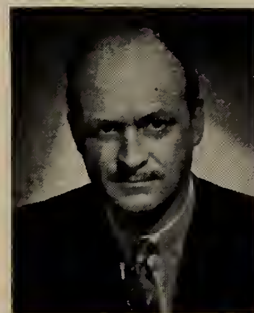
Personals

News of the Personal Activities of Members of the Institute

R. A. Phillips, M.E.I.C.



N. S. Crerar, M.E.I.C.



C. P. Beaubien, M.E.I.C.

J. Herbert Smith, M.E.I.C., (B.Sc., elec., New Brunswick, 1932; M.Sc., New Brunswick, 1942), president of the Canadian General Electric Company Ltd., was awarded an honorary doctorate in science at the convocation exercises of the University of New Brunswick in May. Mr. Smith has maintained an active interest in the affairs of the University during his business career.

E. M. Little, M.E.I.C., (B.A.Sc., elec., Toronto, 1925), president of the Anglo-Canadian Pulp and Paper Mills, Ltd., Quebec, Que., since 1945 has been elected chairman of the board.

I. F. McRae, M.E.I.C., chairman of the board of the Canadian General Electric Company Ltd., was elected president of the Canadian Manufacturers Association for the ensuing year at the annual meeting of the group held at Montreal recently. Mr. McRae is general manager of the civilian atomic power department of C.G.E., in addition to his duties as chairman, in the organization.

J. A. Brusset, M.E.I.C., (National School of Mines, St. Etienne, France, 1921), president of the West Canadian Oil and Gas Ltd., and the Battle River Coal Company has been appointed to the Calgary Advisory Board of the Toronto General Trusts.

A. McDougall, M.E.I.C., (B.Sc., civil, Edinburgh, 1938), has been appointed a director in the firm of Sir William Halcrow and Partners (B.C.) Ltd., at Vancouver. Recently he had had professional association with the British Thomson Houston Company (Canada) Ltd., Vancouver, and with the Canadian British Aluminum Company, Baie Comeau, Que.

T. F. Rahilly, M.E.I.C., (B.Sc., mech., Queen's, 1939), of Hamilton Ont., has been elected to the board of directors of the Bridge and Tank Company of Canada Ltd. Mr. Rahilly is general manager of the Hamilton division of the company and president of two subsidiary companies, the Vulcan-Ford Smith Ltd., and the Ford-Smith Machine Company Ltd.

A. Meade Wright, M.E.I.C., (B.Eng., elec., McGill, 1941), has been appointed vice-president of Dow and Company, Inc., Rochester, N.Y., and president of the Rochester Equipment Distributors, Inc. Mr. Wright joined Foundation Company of Canada in 1945 after service with the R.C.N.V.R. as a lieutenant commander. In 1948 he assumed the post of assistant manager for Atlantic Tug and Equipment Company, Inc., Syracuse, N.Y. He became associated with the firm of Dow and Company, Inc., in 1952, and served as a branch manager of the organization.

Claude P. Beaubien, M.E.I.C., (B.Sc., bus., and engineering admin.), of the Aluminum Company of Canada Limited has been appointed an additional vice-president of the organization. Mr. Beaubien has had twenty-three years of service with Alcan in sales and personnel work in the province of Quebec. He leaves the post of manager of the Montreal district sales office to head the department of engineering.

N. S. Crerar, M.E.I.C., (B.Sc., elec., Manitoba, 1938), general manager of power operations for the Aluminum Company of Canada Ltd., has been appointed an additional vice-president of the organization. He has taken over the direction of Alcan's activities in the field of public relations and advertising. With Alcan since 1939 he has been during the last few years vice-president and general manager of Sagpower and manager of Eastern power operations for Alcan.

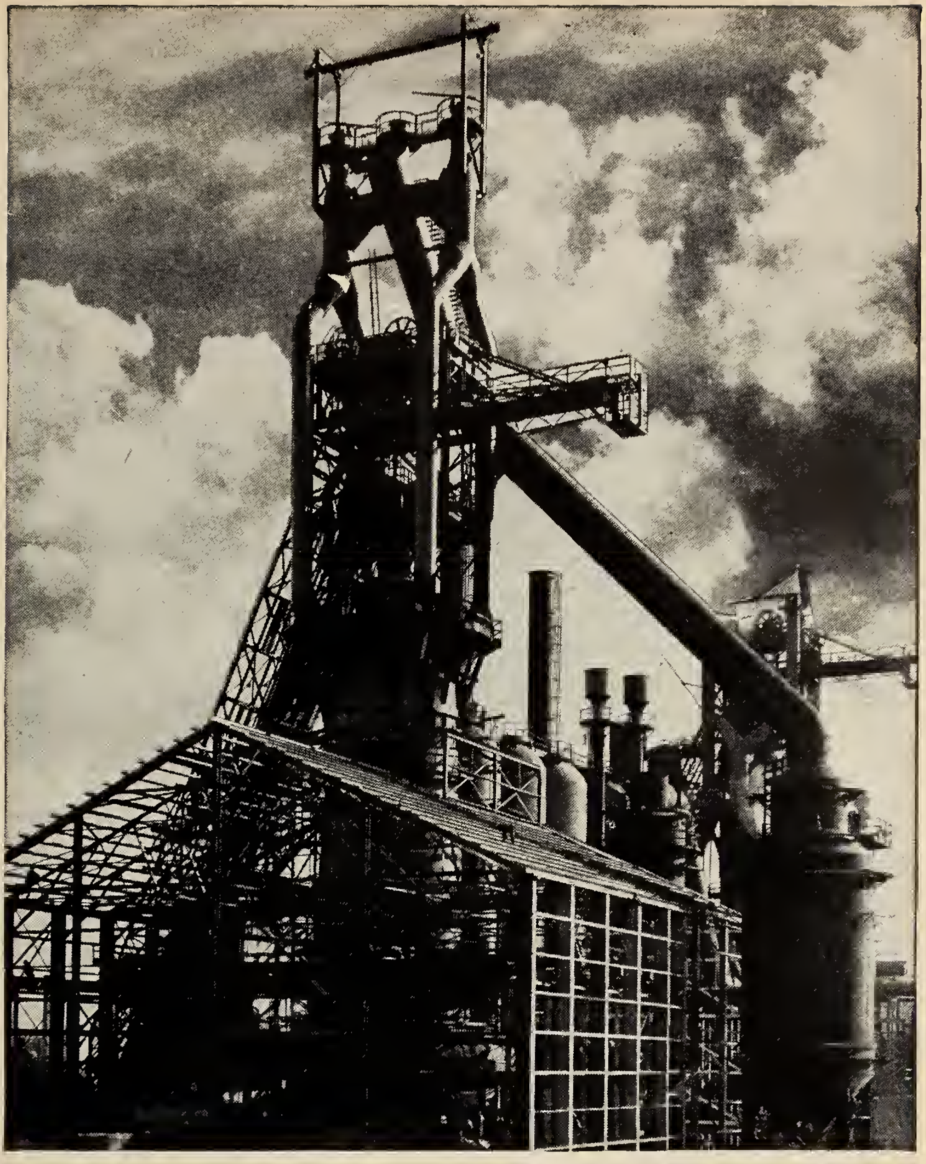
Roy A. Phillips, M.E.I.C. (B.A.Sc., British Columbia, 1939), has taken over the post of manager, marketing, in the Canadian General Electric Company's appliance and television receiver department, at Montreal. Prior to his present appointment he was manager, marketing research and product planning, in the appliance and television receiver department.

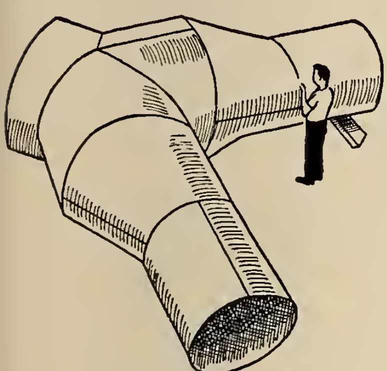
M. P. Whelan, M.E.I.C., (B.Sc., elec., McGill, 1921; M.A. Sc., elec., Toronto, 1922), has been elected to serve the

J. H. Smith, M.E.I.C.

A. M. Wright, M.E.I.C.

M. P. Whelan, M.E.I.C.





• PERSONALS

Toronto Branch of the E.I.C., as one of its councillors for a two-year term, replacing K. F. Tupper, now serving as president of the E.I.C. He has served on the executive committee as well as other committees of the Toronto Branch for a number of years.

Mr. Whelan joined the staff of the Toronto Hydro-Electric System in 1922 and has devoted most of his time to technical sales or administrative work. For several years he was industrial electric heating engineer and at the present time is manager of the demand and rates department. He has served for a number of years on the rates committee of the Association of Municipal Electric Utilities. As a member of the Toronto Board of Trade, he has been active on their advisory engineering and planning committee. Mr. Whelan is also a member of the American Institute of Electrical Engineers and the Canadian Electrical Association.

W. G. Palmer, M.E.I.C., (I.C.S., 1921), of Calgary, formerly vice-president for engineering with the firm of Mannix-Gill Limited, Calgary, has transferred his services to the Canadian Fina Oil Limited, also in that city. His present appointment is that of chief gas engineer.

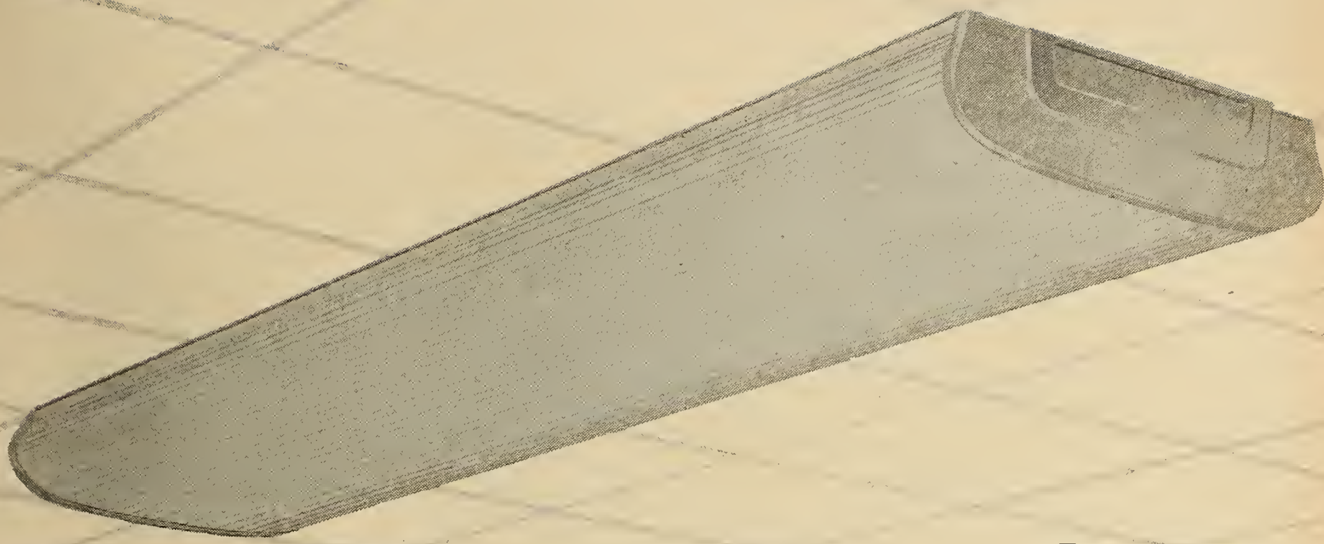
Charles M. Harding, M.E.I.C., (B.Sc., elec., Alberta, 1936), of Seattle, Wash., has for several months held the post of electrical engineer with the Boeing Airplane Company, of Seattle, Wash., Earlier Mr. Harding was associated with H. A. Simons Ltd., Vancouver, Canadian Carborundum Company, at Shawinigan Falls, Que., and the Calgary Power Company.

J. C. Traynor, M.E.I.C., (B.Sc., civil, Sask., 1942), is the newly elected chairman of

J. C. Traynor, M.E.I.C.

the Saskatchewan Branch of the E.I.C. He also serves as president of the Association of Professional Engineers of Saskatchewan. Mr. Traynor is associated with the Department of Transportation, surveys branch.

G. D. Lewis, M.E.I.C., (B.Eng., elec., N.S.T.C., 1942), of Dominion Engineering Works Ltd., Montreal, has been appointed manager of the paper machinery



● PERSONALS

division of the firm. Mr. Lewis transferred to the paper machinery division of the company in 1956 following service as secretary of the firm and was, until his present appointment, employed as manager of contracts.

Fred L. Perry, M.E.I.C. (B.Sc., chem., Queen's, 1942), process superintendent, Imperial Oil Refinery, Calgary, has been named chairman of the Calgary Branch, E.I.C. Mr. Perry has been associated with the manufacturing department of Imperial Oil for the past sixteen years, at

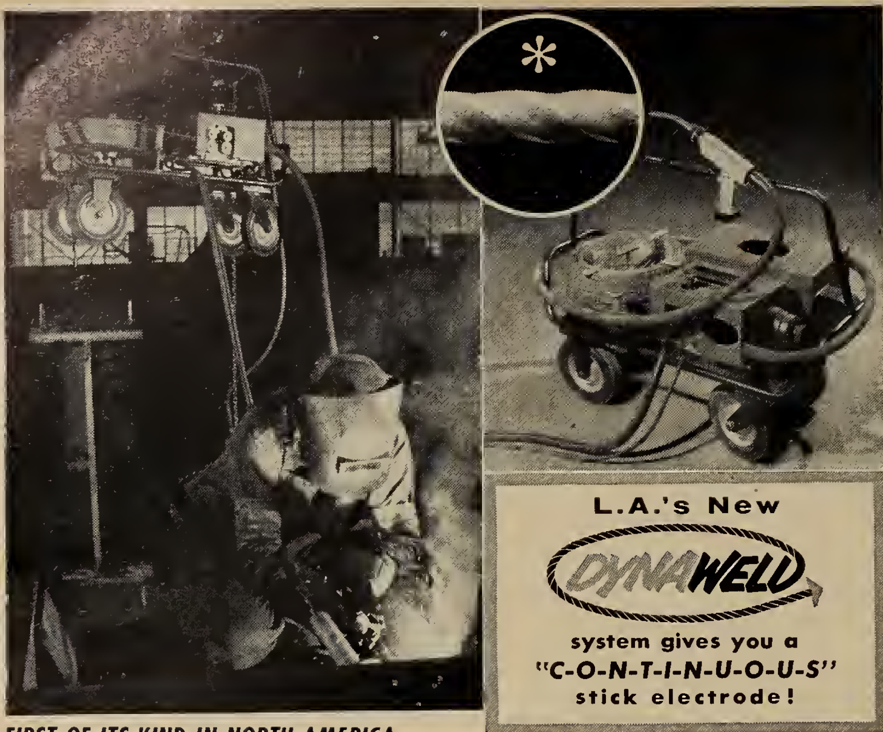
F. L. Perry, M.E.I.C.

the Halifax refinery, and as technical superintendent at Calgary, before taking over his present duties. He has shown interest in professional development programming and in various annual meeting and local technical program activities.

L. MacC. Allison, M.E.I.C., (Dalhousie, 1911), of Armdale, N.S., for many years associated with the Department of Public Works of Canada, has retired. Mr. Allison began his career with the Department of Railways and Canals on railway construction. At about this time he took part in preliminary surveys carried out in connection with the development of the St. Lawrence River. During World War I he served with the 25th battalion Canadian Expeditionary Force. He gained experience on highway construction, as resident engineer for the Department of Highways, for the province of Nova Scotia in the early nineteen twenties. In 1924 he took on the work of junior engineer, Public Works, at Halifax. In this service he was engaged in harbour and river construction and maintenance. He remained in this work until the time of his retirement as assistant to the district engineer in 1957.

R. N. Coke, M.E.I.C., (B.Sc., elec., McGill, 1914), chief engineer for the metropolitan operation division of the Quebec Hydro-Electric Commission has retired. He continues to be associated with the organization as a consulting engineer.

Following service in World War I and early experience with a number of electrical and power companies Mr. Coke joined the staff of the Montreal Light, Heat and Power Consolidated as assistant general superintendent in 1929. In due course the firm became known as



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Among its many advantages is the substantial increase in productivity when the system is properly used on suitable applications. This results from the high duty cycle and the higher-than-usual current rates used, with consequent greater deposition of weld metal. Simple to use, the L.A. Dynaweld process is *completely independent of water cooling or gas shielding.*

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No complex mechanical or electronic apparatus is involved in the Dynaweld system, nor is any auxiliary apparatus (other than the source of welding current) required in its operation. Extremely portable and flexible in use, the ruggedly built machine has few moving parts and maintenance is negligible.

The L.A. Dynaweld system is highly recommended for production mild steel welding operations where presently large quantities of conventional or iron powder stick electrodes are being used. Metallurgically, weld deposits from Dynaweld wire are comparable in every way to those from standard mild steel stick electrodes in the AWS E 6012, E 6024, and E 6020 classifications.

For further information about the new L.A. Dynaweld system, contact your local Branch office of Canadian Liquid Air Company Limited, where arrangements can be made for a practical study of your plant's welding applications to determine the suitability of this process for your operations.

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• PERSONALS

the Quebec Hydro. He was appointed vice-chief engineer, and general superintendent in 1934, and promoted to chief engineer, operating division, Montreal, a few years later.

P. V. Palmer, M.E.I.C., (B.A.Sc., civil, Ecole Polytechnique, 1945), chief engineer with the Howard Smith Paper Mills Limited, Montreal, now serves the firm at Cornwall, Ont. The central engineering department, previously located at Montreal, was moved to the Cornwall division of the company in May.

K. K. Hyde, M.E.I.C., (Kingston Tech. Coll., Surrey, England, 1952), who has been following his career in Malaya for some time, has taken over the post of resident engineer with Messrs. Keith Edmunds and Associates for Sungala Camp, Port Dickson, Malaya. Last year Mr. Hyde was an assistant engineer with the Federation of Malaya drainage and irrigation department.

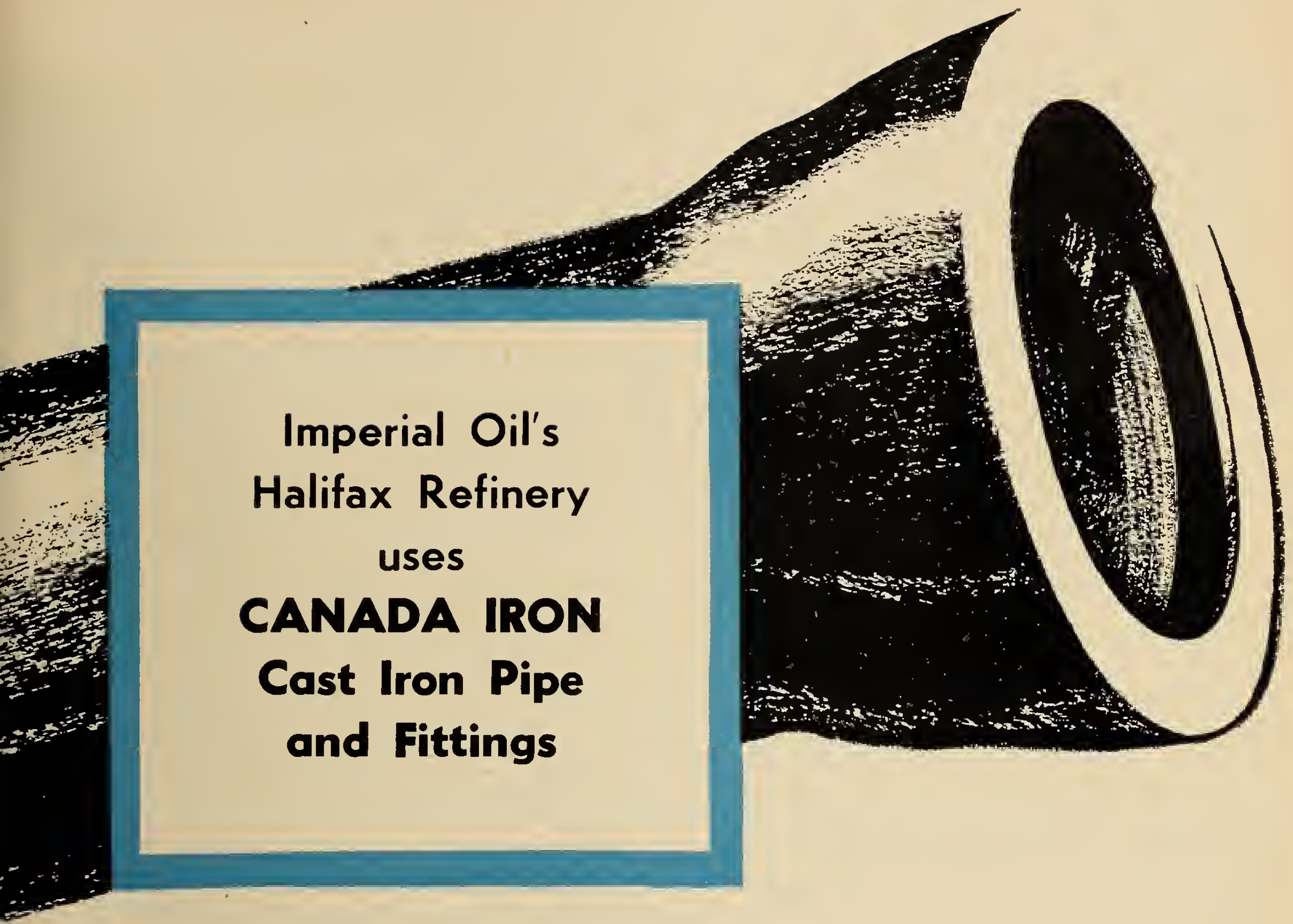
T. A. Jull, M.E.I.C., (B.A.Sc., mech., Toronto, 1943), has been named vice-president, sales, with Eastern Steel Products Ltd. Mr. Jull held executive sales posts of a technical and engineering nature with the John Inglis Company Ltd., Montreal, and other major Canadian companies prior to joining Eastern Steel.

J. W. Forster, M.E.I.C., (B.Sc., civil, Alberta, 1944; M.Sc., hydrology, Iowa State, 1947), is superintendent of hydraulic and power studies with the Aluminum Company of Canada Ltd., of Kitimat, B.C.,

G. E. Baldwin, M.E.I.C., (B.Sc., civil, Sask., 1955), has transferred from Saskatoon to Swift Current, Sask., as division engineer with the Department of Highways and Transportation. Last year Mr. Baldwin worked as a project engineer with the construction branch of the department.

W. A. Pangborn, JR.E.I.C., (B.Eng., civil, McGill, 1953), of the Three Rivers, Que., firm of John F. Wickenden Company Ltd., was chosen to represent the province of Quebec and Eastern Ontario at the zonal contest of the Toastmasters' International in Boston this month.

John A. Maguire, JR.E.I.C. has recently completed a fifteen-month training program in the production engineering department at Pratt and Whitney aircraft division of United Aircraft Corporation, East Hartford, Connecticut, U.S.A. He has returned to Canadian Pratt and Whitney Aircraft Company Limited, Longueuil, Que., where he will work in the production engineering department.



Imperial Oil's Halifax Refinery uses CANADA IRON Cast Iron Pipe and Fittings

For its new refinery at Halifax, Imperial Oil Limited chose Canada Iron cast iron pipe and fittings for its underground water distribution services, and Canada Iron cement--lined cast iron pipe and fittings for its underground drainage system.

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NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

BRITISH COLUMBIA

Is It Ethical?

(Taken from the B.C. Professional Engineer bulletin of the British Columbia Association of Professional Engineers, May issue.)

A discussion on ethics is presently being carried in the B.C. Professional Engineer in the form of questions and answers.

The questions are taken from those submitted to a panel discussion meeting held in January, the answers being reviewed by the Ethics Committee.

Question 3. Is it ethical for a consulting engineer to accept a manufacturer's commission on certain specific types of machinery to the exclusion of competitive equipment?

Answer: The Code of Ethics is quite explicit on this in Section III (9). This reads as follows: "He will not receive, directly or indirectly, any royalty, gratuity, or commission on any patented or protected article or process used in work upon which he is retained by his client, unless and until receipt of such royalty, gratuity or commission has been authorized in writing by his client."

It is covered again by Section III (7) which reads as follows: "He will inform his clients of any business connections, interest or circumstances, which may be deemed as influencing his judgement or the quality of his services to his clients." If a consulting engineer, therefore, acts also as a manufacturer's agent for certain types of equipment, he should at the outset, when retained by a client, advise that client in writing that he is the agent for that equipment.

Question 4. Would you comment on the responsibility of the employed engineer to the public in regard to unethical stock promotion by his employers?

Answer: Again we should refer to the Code of Ethics, namely Section I (4), which reads as follows: "He will not associate himself with, or allow the use of his name by, an enterprise of doubtful character." I do not believe there is any question about his action in such a case, whether as an employed engineer or as a consulting engineer. If the former, he should resign and if the latter, he should advise his clients that he does not wish to carry on with his commission. In doing so, he should, of course, advise his clients or employers in writing of his reason for his action. Whether he should make a public statement as to these reasons is another question, of course, and much would depend upon the circumstances surrounding the case.

Taken at the E.I.C. annual meeting, Quebec, this photo shows Members of the C.P.E.Q. reviewed plans for the fifth annual provincial golf tournament at Grand' Mere, Que., June 21. L to r., seated, C. G. Cook, P.Eng., F. A. Patterson, P.Eng., L. G. Boivin, P.Eng., committee chairman, W. J. Riley, P.Eng., vice-pres., C.P.E.Q. Back; J. P. Woods, P.Eng., P. Vincent, P.Eng.

ONTARIO

Canadian Council Annual Meeting

(Taken from "The Professional Engineer, Journal of the Association of Professional Engineers of the Province of Ontario.)

Early in May official representatives of the provincial registering bodies of professional engineers met in Vancouver, B.C., for the 21st annual meeting of Canadian Council of Professional Engineers. If a co-operative spirit of approach to the solution of problems of mutual concern is any indication, the meeting should certainly be regarded as highly successful.

Foremost in interest were the proposals regarding Confederation presented by the joint committee of Canadian Council and the E.I.C. The recommendations of the joint committee to proceed toward the formation of a new national body were approved unanimously by the Council but subject, of course, to the approval of each member Association.

The licencing of foreign engineers to permit them to temporarily undertake professional engineering in Canada also was a topic which affected most Associations. There was complete agreement that there is no readymade solution to the problem but there was also agreement with the policy that where competent Canadian engineers are available, these engineers should be employed or retained rather than call upon engineers from outside of the country.

With an agenda of over forty items of general business, space does not permit of more than the naming of a few—the move towards uniform or standardized registration by all associations: the creation of a code of ethics which could be adopted by all member bodies: the syllabus of examinations, now employed by all Associations; the annual Canadian Council Survey of Salaries and a new form of salary schedule; professional pay for members of the armed services; civil defence; counselling of students as to the engineering profession; the accreditation of engineering courses in universities; progress in the certification of engineering technicians; abuse of the word "engineer," or "engineering," in corporate names. These were but a few of the topics discussed and which action was taken during the three-day sessions.

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NEWS OF THE BRANCHES

Activities of the Fifty Branches of the Institute and abstracts of the papers presented at their meetings

BAIE COMEAU

Norman Lapierre, JR.E.I.C., *Sec.-Treas.*

George W. Scott, M.E.I.C., *Branch News Reporter*

THE ALUMINUM INDUSTRY throughout the world, was the subject of the greater part of a talk delivered to the Baie Comeau Branch toward the close of the spring season. More than fifty persons turned out to hear W. J. Thomas, managing director of the British Aluminum Company Limited and vice-president of the Canadian British Aluminum Company. Mr. Thomas traced the history of the industry throughout the world and its development and expansion up to the present day. The various factors affecting its growth and economy were discussed, and some reference was made to possible future developments.

The remaining part of the address covered the activities of the British Aluminum Company of which the new smelter at Baie Comeau is now an operating subsidiary, under the Canadian British Aluminum Company.

Film Evening

A film evening on May 14 featured two construction films which were well received by the members. They were "Blasting a New Niagara," and "The Dounreay Sphere."

Resolution on Confederation

At a general meeting of the E.I.C. held on May 14, 1958, in Baie Comeau, Que., it was agreed that the following resolution, voicing the opinion of the members of this Branch regarding Confederation, be presented to the Council of the Engineering Institute of Canada.

1. Whereas, it is desirable that a national body be representative of the whole engineering profession throughout Canada.
2. Whereas, it is desirable that the requirements for the practice of the engineering profession be uniform throughout the country.
3. Whereas, it is desirable that registration in a national body permits the practice of the profession throughout the land.

Whereas, it is desirable that one fee covers registration at provincial and national levels.

Therefore it is resolved that the members of the Baie Comeau Branch of the E.I.C. support and second the work of the Council of the Engineering Institute of Canada towards the forming of a national body representing the engineering profession throughout Canada.

BELLEVILLE

F. E. Moore, M.E.I.C., *Sec.-Treas.*

T. E. Flinn, M.E.I.C., *Branch News Reporter*

TWO GUEST SPEAKERS described the growth of the plywood industry in Canada and industrial research and uses, at a talk given May 13, 1958. They were Evan L. Fowler, Eastern field supervisor, Plywood Manufacturers' Association of British Columbia, and Robert Armstrong, field supervisor of the organization for Central and Northern Ontario. It was pointed out in the course of the talk that Canada, on a per capita basis is the greatest user of fir plywood. A film entitled, "The Plywood Story" was shown.

N. Throop introduced the speakers. They were thanked by W. Benger.

A.P.E.O. Report by E. Pugh

E. Pugh presented a report on the proceedings of a recent council meeting of the Association of Professional Engineers of Ontario at Toronto which he attended as an observer. Confederation was one of the subjects discussed. Members of the A.P.E.O. of the Belleville area who were not members of the Branch received a special invitation to attend the meeting in order that they might hear Mr. Pugh's report.

HALIFAX

J. E. Reardon, M.E.I.C., *Sec.-Treas.*

THE ALASKA HIGHWAY and the collapse of the Peace River Bridge was the matter brought to the attention of the Branch April 16, when Lt. Col. M. C. Sutherland-Brown addressed the meeting.

Lt. Col. Sutherland-Brown is the assistant-quarter-master general, at headquarters, Eastern Command, Halifax. Formerly senior highway engineer with the Northwest Highway System in the Northwest Territories, he discussed the work in this area in general terms. In the second part of his talk he related events leading up to the collapse of the Peace River Bridge, and data correlated from the investigation of the collapse of this structure.

A tour of the National Research Laboratory at Halifax was enjoyed by the Branch on May 13. A tour and inspection of the Royal Canadian Naval Air Station, H.M.C.S., Shearwater, was slated for June 21.

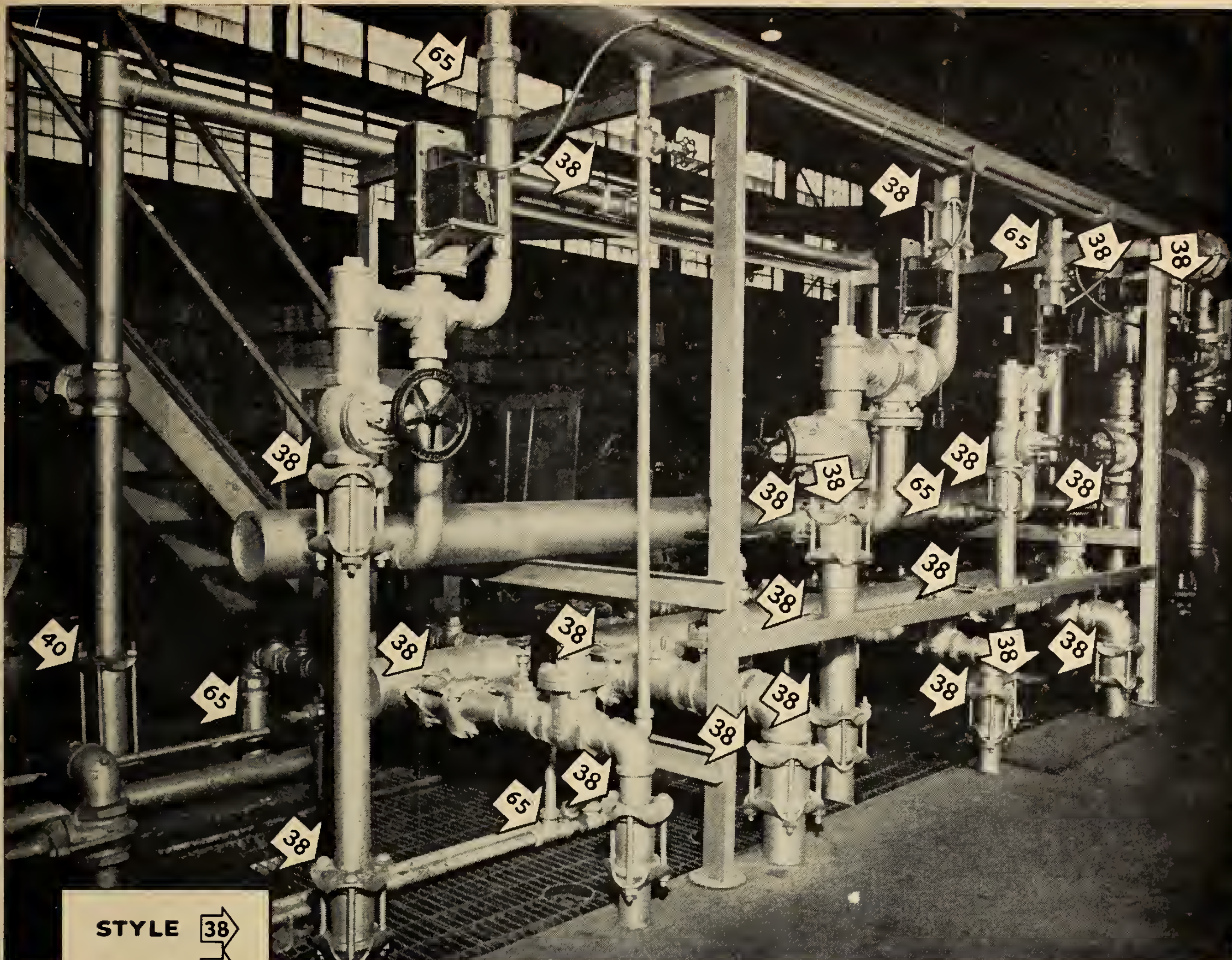
LONDON

W. C. Sinkins, JR.E.I.C., *Sec.-Treas.*

J. Wartena, M.E.I.C., *Branch News Editor*

NEW CONSTRUCTION at Wolseley Barracks, London, Ont., was discussed by Major D. C. MacMillan, camp engineer, at a May 20 meeting of the Branch. The talk was preceded by a visit to the new

The department of engineering science, University of Western Ontario, has completed a four-year engineering science curriculum. Graduates are: (back, l. to r.), J. G. McLarty, J. B. Robinson, R. F. Hunt, L. H. McGill, J. M. Trenouth, J. S. Bedggood, K. P. Bellis, H. H. Keys, R. C. Robotham, T. B. Collings, R. L. Judd, and R. E. Durnin.



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buildings. Thirty members of the E.I.C. heard Major MacMillan outline the way in which military camps in Canada are composed of standard buildings, modified to site conditions by local consultants. The duties of a camp engineer and of the R.C.E.M.E. were also summarized.

The improved layout and facilities of the camp impressed members who saw a mess with a seating capacity of five-hundred, a drill hall, administration building, barracks block, central heating plant, physical training centre, chapel, officers' mess and a swimming pool of particularly modern design.

OTTAWA

W. V. Morris, M.E.I.C., *Secretary*

A. H. Graves, S.E.I.C., *Publicity Chairman*

MAJOR CITY PROJECTS were reviewed by F. E. Ayers, director of planning and works, City of Ottawa, before an attendance of seventy-five, at a Thursday luncheon meeting of the Branch, April 17.

Mr. Ayers predicted that a giant thruway system would be "real" within months, as major improvements in roadway facilities were effected. These would include Queensway Limited Access Highway, Carling Avenue, Bronson Canal Bridge and other major projects scheduled for the immediate future.

He predicted among other things, that when the eastern approaches to the $31,000,000 limited access Queensway are completed next year it will be possible for incoming traffic to travel non-stop directly into Nicholas Street and on to the heart of the city.

Rockets and Satellites

At a joint meeting with the A.I.E.E., the Ottawa Branch, on May 1, heard Gordon D. Watson, director of weapons research, Defence Board, in a lecture on "Rockets, Earth Satellites and Space Travel." Mr. Watson is responsible for the co-ordination and planning of the Canadian research program in the weapons field. His illustrated lecture provided up-to-date information about rockets and earth satellites, which are forerunners of the space travel age.

It is hoped that the lecture will be published in abstract form in an early issue of the Journal.

Colombo Plan Talk

John P. Sterling, chief engineer, Defence Construction, 1951 Ltd., addressed the Thursday luncheon meeting of the Branch on "The Colombo Plan – Canadian Engineers Look Eastward," at a May 15 meeting.

Defence Construction 1951 Ltd., is technical adviser and contracting authority for the Colombo Plan Administration, Department of Trade and Commerce. Mr. Stirling, who has recently returned from an inspection trip to construction pro-

jects in India and Pakistan, spoke on the engineering features and construction methods of various projects. Coloured slides accompanied the talk.

MONTREAL

G. M. Boissonneault, Jr.E.I.C.
Sec.-Treas.

J. D. DENOVAN, Jr.E.I.C.
President Publicity Committee

THE CIVIL SECTION of the Montreal Branch, at a special meeting on April 23 heard Fred N. Severud, of Severud, Elstad and Krueger, Associates, consulting engineers of New York, in a talk on the developments in the field of hung structures.

Chairman of the meeting was Dr. P. L. Pratley.

Mr. Severud, one of America's foremost structural engineers, and author of several books (co-author of "The Bomb, Survival and You.") is the designer of many of the world's most impressive and advanced structures and presently consulting engineer on the Ville-Marie Plaza development in Montreal. Invited to attend the meeting also were members of the Province of Quebec Association of Architects.

SAULT STE. MARIE

R. L. Wimperis, Jr.E.I.C., *Sec.-Treas.*

A GUIDED TOUR of the Mannesmann Tube Company plant in Sault Ste. Marie was held on May 2, 1958, replacing the usual formal dinner meeting of the Branch. The tour was a follow-up of a talk given January 1957, by E. A. Gilmore, general superintendent of the mill. (See March 1957 issue of the Journal, p. 346). Production of seamless tubes, primarily for oil-well consumption and for the transmission of overland oil and gas began in 1957.

The mill was shown in order of production and was briefly as follows: No. 1 piercer where the first hole is pierced in the white hot tube round; No. 2 piercer where the hole is enlarged and the round is lengthened; plug mill, where the inside and outside diameters are roughly formed; reeler, where the outside diameter is exactly formed; sizing mill, where the exact outside diameter is formed; cooling beds; tube straightening; x-ray inspection; coupling screw-on machine; 13,000 p.s.i. hydrostatic tester; coating tube with rust preventative.

The mill also produces the tube couplings. It is the most modern seamless tube mill in the world and almost all operations are automatically operated.

TORONTO

D. S. Moyer, M.E.I.C., *Sec.-Treas.*
Gordon F. R. Norton, Jr.E.I.C.,
Branch News Reporter

THE COST OF HOUSING was reviewed by R. F. Legget, director of the National Research Council, division of building research, Ottawa, on April 10, 1958.

Mr. Legget opened his remarks by extending warm greetings from the Ottawa Branch to the Toronto Branch. He discussed the costs involved in housing under the headings of capital cost, and systematically followed the steps involved in assessing each of these. A comparison was made between the cost of buying a home as opposed to renting, and from the figures used, it was shown that there is little difference, except that the home buyer does have an equity in the building as the mortgage is paid off. Mr. Legget suggested some possibilities for reducing housing costs as: smaller houses, greater concentration of units (to reduce transportation and facilities), technical improvements, and an increase in the period of amortization.

The Joint Area Committee held a panel on civil engineering on April 3, 1958 at the University of Toronto. D. D. Whitson acted as moderator. D. F. Morrison answered questions on structural problems; Dr. A. E. Berry, municipal questions; D. G. Huber, the hydraulic queries; W. L. Sagar, soil mechanics; and A. M. Toye, highways and bridges.

METHODS USED IN RUSSIA as opposed to those used in the Western world were discussed from an engineering point of view when P. E. Cavanagh, of the Ontario Research Foundation addressed the Toronto Branch, April 24, on "The Iron and Steel Industry in Russia."

Recently returned from that country, he noted the lack of understanding between both groups.

Mr. Cavanagh was shown production records, and by cross-checking determined that these records were very accurate. The Russians did not object to questions on politics and showed a willingness to meet other engineers to discuss engineering ideas.

He said that Canadian technical bulletins are distributed almost as soon as they are received. It was found that they would be pleased to make their information available if requested.

Russians and Canadian industry is developing at about the same rate. Industry in Western Russia is reasonably well advanced and organized, but the Eastern part of Russia leaves much to be desired and is badly disorganized.

Mr. Cavanagh found the Russians to be good engineers and very progressive, and paid about ten times the figure for ordinary workers. Professors are the most highly paid persons.

Guests at the meeting were the officials of two British societies T. E. Goldup, president and W. K. Braker, secretary, Institution of Electrical Engineers; and Brian Robbins, secretary, Institution of Mechanical Engineers.

News of Other Societies

Chemical Institute of Canada Annual Meeting

The forty-first annual conference and exhibition of the Chemical Institute of Canada, held at the Royal York Hotel, Toronto, May 26 -28, 1958 drew an attendance of 1300.

Elected president of the organization was C. E. Carson of Toronto, president of Imperial Oil Limited, replacing Osman J. Walker, retiring president.

E. Gordon Young, director, Atlantic Regional Laboratory, National Research Council, Halifax, was named vice-president. Twelve councillors elected during the proceedings were: W. A. Rabb, Shawinigan, Que., D. H. Andrews, McMasterville, Que., L. V. Clegg, Montreal, Que., R. U. Lemieux, Ottawa, D. G. Ritchie, Toronto, L. J. Rubin, Toronto, T. H. Evans, Guelph, Ont., A. M. Kristjanson, Regina, Sask., W. A. E. McBryde, Toronto, J. A. McCoubrey, Toronto, J. Y. Harcourt, Ottawa, and T. L. Davies, Sarnia, Ont. They will serve with other officers whose terms of office continue.

Twenty-two prominent chemists and chemical engineers were elected Fellows of the C.I.C.

More than 150 technical papers were presented at the two-day meeting. They were given at sessions arranged by Divisions of the Institute concerned with the subjects of agricultural chemistry, chemical education, chemical engineering, biochemistry, organic chemistry, physical chemistry, analytical chemistry, protective coatings, inorganic chemistry, rubber chemistry, chemical economics, etc. Several were joint subject division sessions.

Sixteen chemists and chemical engineers from the United States, and England were among those reporting to the meeting on advances in research or development.

Dr. Carl A. Walker of McGill University was awarded the C.I.C. Medal (1958), in recognition of his outstanding contribution to chemistry. The Medal, made of that rare metal, palladium, is provided by the International Nickel Company of Canada Limited. In a special address on this occasion, Dr. Winkler discussed the subject, "Active Nitrogen". He explained that when nitrogen is passed through a suitable electrical discharge a very active form of nitrogen is obtained with which most ordinary substances will react readily, often with beautifully coloured flames. Many of these reactions have been systematically studied at McGill during the past ten years. Dr. Winkler discussed some of them in a relatively non-technical way. The nature of the nitrogen species responsible for the reactivity of active nitrogen was also discussed briefly.

Dr. H. G. Khorana, B.C. Research Council, Vancouver, presented the Merck Lecture on the subject, "Recent Progress in the Synthesis and Structural Analysis of Polynucleotides," sponsored by Merck and Company Limited. Dr. Khorana pointed out that structural analysis of polynucleotides depends greatly on the use of enzymes as tools. A discussion of chemical synthesis was followed by a review of the enzymic studies carried out in the author's laboratory which have elucidated the mode of action of the snake venom and spleen phospodiesterases on polynucleotide chains. These studies have provided promising methods, he said, for the end group determination and stepwise degradation of polynucleotides.

The Montreal Medal was awarded to T. W. Smith, Montreal, formerly associated with Canadian Industries Limited, in recognition of significant leadership in the profession of chemistry or chemical engineering in Canada.

Groups of delegates availed themselves of plant visits to the British American Oil Company Limited, Clarkson Refinery, Dunlop Canada Limited, Whitby, Ont., the Steel Company of Canada Limited, Hamilton, Ont., and the Canadian Packers Limited, Toronto. There was also a demonstration of the sub-critical reactor now installed in the Walberg Building of the University of Toronto.

Several panel discussions were provided for subjects of urgent interest. The subjects were: High School, University and Industry, What Each Expects of the Other in Chemical Education; Promotional Methods in Canadian Chemical Selling, and Techniques.

The physical chemistry subject division invited two guests to present papers. They were Professor A. Sehoh, of McGill University who spoke on "Bond Dissociation Energies," and Dr. C. A. McDowell, U.B.C., on, "The Paramagnetic Resonances of Free Radical", Dr. Paul E. Gagnon of Laval University, Que., was guest speaker at luncheon on May 26, his subject being "The Old Chemist", L. T. Rosser, Mansfield Rubber (Canada) Limited, spoke at luncheon on May 28, on the subject of "Economics in the Canadian Rubber Industry".

His Worship Mayor Nathan Phillips, Q.C., graciously and officially opened the conference and the exhibition.

The exhibition consisted of the latest developments in laboratory and chemical process equipment, scientific instruments, chemicals, and technical literature. Fifty-five manufacturers and distributors took part in the display.

Calendar

I.R.E.–A.I.E.E.
Electrical and Radio Standards Conference, Boulder, Colorado, Aug. 13-15, 1958.

Illuminating Engineering Society
National Technical Conference of the Illuminating Engineering Society, Royal York Hotel, Toronto, Aug. 17-21, 1958. Write: R. W. Sclater, Public Relations, 280 Lakeshore Rd., Toronto 14, Ont.

A.I.C.E.–A.S.M.E.
Heat Transfer Conference, Evanston, Ill., Aug. 18-21, 1958

Ninth International Astronomical Congress, Amsterdam, Netherlands, Aug. 25-31, 1958.

British Association for the Advancement of Science, 120th Annual Meeting, Glasgow, Scotland, Aug. 27-Sept. 3, 19558.

A.M.S.–A.S.C.E.
Second National Conference on Applied Meteorology; Engineering, sponsored by the American Meteorological Society and the American Society of Civil Engineers, at University of Michigan, Sept. 9-11, 1958. Write: University of Michigan News Service, 3564 Admin. Bldg., Ann Arbor, Michigan.

Canadian Construction Association
Summer Regional Meeting, Delaware, Inn, Honey Harbour, Georgian Bay, Ont., Sept. 6-9, 1958. Write: C.C.A., Construction House, 151 O'Connor St., Ottawa 4, Ont.

Institute of Aeronautical Sciences
First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain, Sept. 8-13, 1958. Write: Inst. of Aeronautical Sciences, 2, East 64th St., New York, 21, N.Y.

The Textile Technical Federation of Canada
Sixth Canadian Textile Seminar, Queen's University, Kingston, Ont., Sept. 11-12, 1958. Write: 223 Victoria Ave., Westmount, Que.

Societe des Radioelectriciens
International symposium on nuclear electronics organized by the Societe des Radioelectriciens, sponsored by the Commissariat a l'Energie Atomique and International Union for Pure and Applied Physics, UNESCO House, 2, Place de Fontenoy, Paris, (7); Sept. 16-20, 1958.

LIBRARY NOTES

ADDITIONS TO THE INSTITUTE LIBRARY • REVIEWS • BOOK NOTES • STANDARDS

BOOK NOTES

Prepared by the Library, The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

AIR POLLUTION

This volume is based on lectures given at a course on air pollution held by Sheffield University in 1956.

The first three papers define the problem, and cover the characteristics of solid and gaseous pollutants, the measurement of air pollution and instruments for measuring smoke in chimneys. The next two chapters consider the effects of air pollution on health, vegetation, buildings and metalwork.

A discussion of the geographical factors affecting pollution, and the flow of chimney gas is followed by several papers on methods to be adopted in the elimination of pollution from domestic heating, vehicle exhaust fumes, industrial boilers, the iron and steel industry, refractories, ceramics and cement manufacture. There is also a chapter on selection of equipment for air cleaning.

Two final chapters discuss air pollution legislation, and the British Clean Air Act.

Although much of the information given in the book applies to England, it will prove of interest to all those concerned with the elimination of this serious menace. (Ed. by M. W. Thring. Toronto, Butterworth, 1957. 248p., $8.50.

ANNUAIRE DE L'EQUIPMENT DES INDUSTRIES MECANIQUES, 1957-58

The first part of this Directory comprises an alphabetical list of manufacturers and importers giving for each the address, trademarks, agents in France and abroad, and equipment manufactured indicated by symbols, keyed to section 2.

The second section is a classified list of equipment manufactured.

The three Appendices list trade-names and trade-marks, foreign manufacturers and their French agents, and an alphabetical list in French of the equipment listed in Section 2.

This is a useful directory for any firm interested in machinery, etc., and trade with France. (Ed. by M. Coyaud. Paris, Dunod, 1957. various paging, 1200 fr.)

*BASIC FEEDBACK CONTROL SYSTEM DESIGN

Servomechanism theory and design is presented from a fundamental point of view by means of practical examples. The approach utilized is based on a combination of the root-locus and frequency-analysis method, and while emphasis is on linear servomechanism design, nonlinear servomechanism analysis is included. Along with basic material, information is provided on components, gyroscopes, force-balance transducers, and inertial navigation. (C. J. Savant. Toronto, McGraw-Hill, 1958. 418p., $11.40.)

THE BEAMA CATALOGUE, 4TH ED.

The 1958 edition of the Catalogue issued by the British Electrical and Allied Manufacturers' Association contains over 690 pages of announcements of products manufactured by firms who are members of the Association. The announcements are divided into three sections covering electrical power plant; electrical equipment in industry, transport and communications; domestic and commercial appliances, lighting, accessories and installation material.

There is a Buyers' Guide listing everything electrical, and a five-language glossary of the terms used in it. The Catalogue also contains a Directory of the members of BEAMA. This catalogue will prove most useful to any firms interested in purchasing electrical equipment. (London, Iliffe for BEAMA, 1958. Various paging, £6.)

DISINTEGRATION OF FIELD CONCRETE. INVESTIGATION OF THE EFFECT OF SOME POZZOLANS ON ALKALI REACTIONS IN CONCRETE

These are the first of a series of progress reports to be issued by the Committee on Alkali Reactions in Concrete of the Danish National Institute of Building Research, which is investigating the deterioration of concrete structures caused by reactions between alkalies and reactive silica of the aggregate. It is intended to prepare a code of practice based on the findings of the committee.

The reports are in English, with a Danish resume, and contains many illustrations, tables and references. This should prove a most useful series. (Copenhagen, Danish National Institute of Building Research, 1956-57. mimeog., 12 D.Kr. each.)

*DRAINAGE OF AGRICULTURAL LANDS

The methods and means used to drain land are studied in relation to water tables, movement of water through soil, and the relationships that exist between water tables and crops. Aspects dealt with include the physics and engineering aspects of land drainage, drainage investigation methods, and land drainage in relation to soil and crops. There are 32 pages of references at the end of the book. (J. N. Luthin. Madison, Wisc., American Society of Agronomy, 1957. 620 p., $11.00.)

ECONOMIC APPLICATIONS OF ATOMIC ENERGY

Prepared for the 24th session of the Economic and Social Council of the United Nations, this report considers the possible applications of atomic energy in the fields of power, industry and agriculture.

THE ENGINEERING INSTITUTE LIBRARY

The publications mentioned in these Notes are now available in the Library. Members of the Institute may borrow books, periodicals, pamphlets, etc. from the Library. The loan period is two weeks, excluding time in transit, and two items may be borrowed at one time. Library hours are: Monday to Friday: 9 a.m. — 5 p.m.

Because of a recent change in policy, publications (except periodicals published by other engineering societies) may no longer be purchased through the Library. If members have difficulty obtaining material locally, it is suggested they write to the Library, and the enquiry will be forwarded to an appropriate bookseller. For further information write to the Librarian.

• LIBRARY NOTES

The first section considers such topics as the present demand for electric power; the economic aspects of power generation by conventional and nuclear power plants; industrial uses of radioactive materials and radiation; the potential uses of atomic power in agriculture and related industries.

The second section of the report contains the replies to questionnaires sent to the governments of Canada, France, the U.S.S.R., the U.K., and the U.S. These were concerned with each country's electric power needs, the objectives of its nuclear power programme, its present and future activities in the field, the factors determining the use of conventional power plants. Also considered in this second section were labour and training problems associated with the use of atomic energy. (United Nations, Secretary-General. Toronto, Ryerson, 1957. 108p., 50 cents.)

*ELSEVIER'S DICTIONARY OF ELECTRONICS AND WAVEGUIDES IN SIX LANGUAGES

Contains terms which relate to electronic engineering rather than to physical electronics. Over 2,000 words are defined in English according to the most precise international standard available. Corresponding terms then appear in French, Spanish, Italian, Dutch, and German arranged in a horizontal fashion. An index to the foreign term provides access to the related English term and its definition. Where necessary, a difference between British and American usage is made clear. (W. E. Clason. Toronto, Van Nostrand, 1957. 628p., $17.50.)

EXTRUSION OF PLASTICS

The first of a series of ten monographs to be issued under the auspices of the Plastics Institutee, this volume is concerned with one of the most important processes in the manufacture of plastics.

The subject is covered from both the theoretical and practical points of view, and chapters are included on the basic principles of extrusion and the complete extrusion process; single and multi-screw extrusion machines; materials for extrusion; the extrusion of thermosets. References are included in each chapter.

Other volumes to be published in the series will cover compression moulding design, compression and injection moulding plant, calendering, polyamides, polyesters, and ethenoid plastics. (E. G. Fisher. London, Iliffe for the Plastics Institute, Toronto, British Book Service, 1958. 114p., $4.50.)

FINANCIAL POST SURVEY OF OILS, 1958

According to this year's Survey, natural gas is the driving force in Canada's oil and gas industry, having taken over from oil which has set the pace in the ten years since Leduc. The Trans-Canada pipeline should be completed this year, and will provide a large new market. Westcoast Transmission is already operating to the west coast.

The survey reviews some 500 oil producing, refining, pipeline, exploration and drilling companies, giving for each company its address, activities, subsidiaries, if any, directors, capitalization, property, development, dividends, etc.

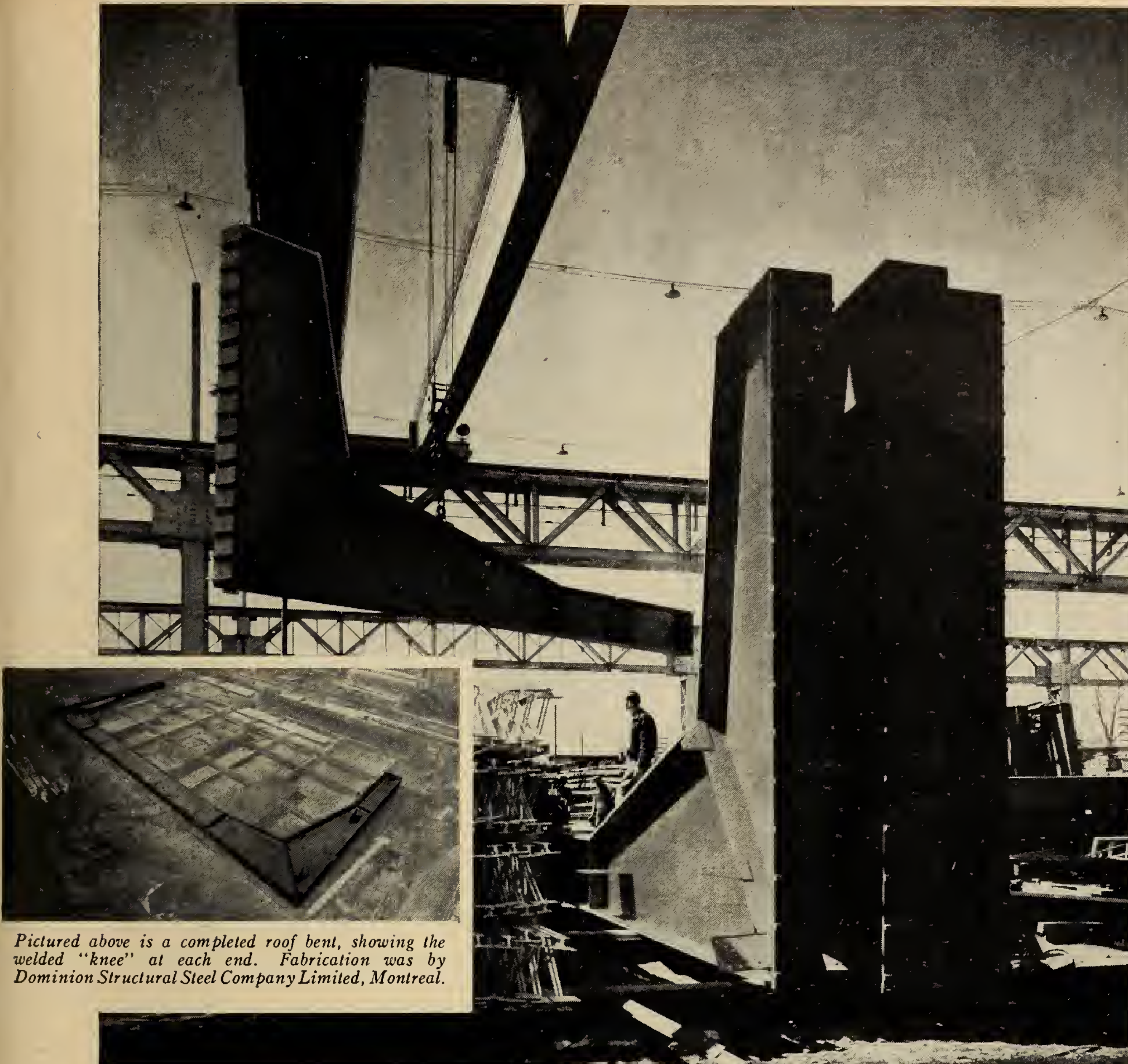
Also included are maps of oil and gas fields, an eight year price range of stock movements, oil and gas production and reserves, imports, etc., and a list of inactive and defunct companies. (Toronto, Maclean-Hunter, 1958. 248p., $4.00.)

PHYSIQUE ELECTRONIQUE DES GAZ ET DES SOLIDES

The main purpose of this volume is the study of the properties of the electron in matter, and its visible results, especially electrical and thermal conductivity. As little is known of the action of electrons in liquids, the author has concentrated on solids and gases.

The first part of the work is theoretical, although purely mathematical proofs are put in the appendix. There is an introductory chapter on physics and mechanics, and other sections cover corpuscular physics, the results of the kinematic theory of gases formed from one or more types and a discussion of "Lorentz gas".

In part two the results of the passage of an electric current through gases and solids is discussed, giving proven results of general interest, referring to



Pictured above is a completed roof bent, showing the welded "knee" at each end. Fabrication was by Dominion Structural Steel Company Limited, Montreal.

other works on the same subject.

This book will be useful to those interested in the study of problems connected with the kinetic theory of gases, to physicists interested in solid state, and to engineers wanting an overall view of the whole problem. (Michel Bayet. Paris, Masson, 1958. 246p., 4900 fr.)

PRECIS DE METALLOGRAPHIE

Based on lectures given at the Ecole Centrale in Paris, this volume contains a concise outline of the phenomena observed during the solidification of metals and alloys.

The first part of the book is concerned with the structure and properties of metals and alloys, including atomic structure, plastic deformation, binary and ternary alloys, etc. In the second part there are studies of several industrial alloys, including special steels, cast iron, copper and its alloys, light weight and ultra-light alloys such as aluminum and magnesium, and electrochemical corrosion. (Leon Guillet. Paris, Masson, 1958. 254p., 1800 fr.)

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Canada. N.R.C. Division of Building Research

Bibliography no. 13. An annotated bibliography on permeability and waterproofing of concrete, by F. Kocataskin.

Building note no. 33. Fire retardants for wood, by D. C. Tibbetts.

Building no. 34. Computed maximum snow loads, by M. K. Thomas and D. W. Boyd.

Buiding note no. 35. Computed maximum wind gust speeds, by M. K. Thomas and D. W. Boyd.

Building note no. 36. Modular co-ordination and building components, by S. R. Kent.

Research paper no. 43. Structural test of a house under simulated wind and snow loads, by D. B. Dorey and W. R. Schriever.

Research paper no. 51. Load distribution test Sussex Street Bridge, Ottawa, Canada, by W. D. Houston and W. R. Schriever.

Technical paper no. 48. Winter concreting trends in Europe, by E. G. Swenson.

Electrical Engineering

Electrical Research Association; technical reports: D/T101—Flame-proof electrical apparatus: flanged joints, one half inch in radial breadth, in mixtures of 1:3-butadiene and air, by T. J. A. Brown and N. Simpson. D/T103—The effect of acid etching on well glasses for flameproof lighting fixtures, by H. G. Riddlestone. G/XT85—Performance and post arc resistance of E.R.A. side blast baffle circuit breaker in heavy current test, by W. D. Whitney and L. Gosland. L/T326 — Electrical properties of tungsten trioxide. (interim report) by J. Hirsch. L/T330 — The concentration of current at arc cathodes, by A. E. Robson. L/T349 — The emission of ionising radiation during a spark discharge, by W. A. Prowse and G. R. Bainbridge.

India. Central Water and Power Commission

Bhagirath pamphlet no. 1, Major water and power projects of India.

Bhagirath pamphlet no. 2, Population and food production.

Mathematics

A treatise on plane and advanced trigonometry, by E. W. Hobson, N.Y., Dover, 1928, 7th ed.

Microscopes

Microscopium, by M. Rooseboom, Leiden, 1956.

Science

Some British records and achievements in science, industry and technology. Gt. Brit., Central office of Information.

U.S. Highway Research Board

Bulletin 168, Fundamental and practical concepts of soil freezing.

Bulletin 169, Developing concepts of land acquisition, 1957.

Welding

Present position of testing methods for welding control, by A. H. Goodger. National Boiler & General Insurance Co. Ltd., Manchester.

STANDARDS RECEIVED

ASTM standards. American Society for Testing Materials, 1916 *Race St., Philadelphia 3, Pa.*

ASTM standards on electron-tube materials.

ASTM standards on iron castings.

Canadian Standards. Canadian Standards Association, 235 *Montreal Rd., Ottawa* 2.

CSA C22.2, no. 16-1958: Construction and test of insulated conductors for power-operated radio devices.

CSA C22.2, no. 101-1958: Construction and test of electrically heated bedding.

QUEEN'S UNIVERSITY

Two Professors of

Mechanical Engineering,

To do Research and Teaching in Thermodynamics

PH.D., preferred, but not necessary

Apply to:

Dean H. G. Conn,
Faculty of Applied Science,
Richardson Hall,
Queen's University,
Kingston, Ontario.

lated to construction and house building industry and product application (no sales), want a through training program in British Columbia to equip you for the job. Write to File No. 6462-V.

CANADIAN ELECTRONICS COMPANY requires a mechanical or electrical engineer with production operation experience and a good knowledge of production control, methods, material control and shop practice applicable to the production of a variety of highly-engineered electronic and electro-mechanical devices. Precision machine shop experience necessary. Age over 35. Salary $10,000 upwards according to qualifications. File No. 6465-V.

ENGINEER REQUIRED by Ontario Manufacturer of packaging films to assume responsibility for the plant engineering department. Must be a graduate with a minimum of ten years' industrial experience. Some design experience of chemical or process equipment would be a recommendation. Age 30 to 38 years. This is a permanent and interesting position with a growing company in a rapidly developing industry. Apply giving full details of experience, age and salary expected. File No. 6466-V.

SEVERAL YOUNG ENGINEERS to train as technical assistants towards positions in production supervision. Metallurgical and Mechanical Engineers are preferred and we should like to interview applicants who have been engaged in steel making or any other basic industry from one to three years. We are prepared to consider 1958 graduates. Location Ontario. File No. 6467-V.

THE FACULTY OF ENGINEERING, McGill University, invites applications from suitably qualified persons to fill three new Professorships: (a) in the field of control engineering; (b) in the field of aircraft and missile propulsion; (c) in the field of applied mechanics with particular reference to such problems as soil and rock mechanics. The essential quality sought in applicants is the ability to initiate programmes of graduate study and research and to develop strong graduate schools. The normal academic session is seven months leaving four summer months for full time research activities. Funds will be available to initiate such research. The initial salary will be in the range $10,000 to $13,000 per annum. Applications, including a statement of academic, industrial and research experience, and the names of three referees, should be sent to Dean D. L. Mordell, Faculty of Engineering, McGill University, Montreal 2, Quebec. File No. 6468-V.

UNUSUAL OPPORTUNITY for a professional engineer, age 28-35, for ultimate top management position with a modern, aggressive, industrial enterprise in Halifax, Nova Scotia. Applicant should have a mechanical or electrical background, and possess the necessary experience and qualifications to handle people in a successful manner. Basic function of position with be the management of entire manufacturing operations of the Company. This is a challenging life-time opportunity. Initial letter to outline complete background and recent photo. Salary range will definitely allow for adequate compensation for high level qualifications. Only those engineers interested in working hard to learn and then to ultimately assume the responsibilities that this position demands need apply. File No. 6475-V.

DISTRICT SALES ENGINEER. A well-established Saskatchewan industry has an opening in Saskatoon for a District Sales Engineer to represent the company in sales and technical services to customers. Applicants should be graduate civil engineers or equivalent, with sales and construction experience, particularly related to concrete. Ability to write technical reports and promotional material essential. Must have the capacity to work with a minimum of supervision, and to manage the activities of a branch. Age range 28-35 preferred. Initial salary $500-$600 per month plus fringe benefits and a car. This is a favourable opportunity for a man capable of assuming substantial responsibilities. Write in strict confidence, giving full information and a recent photograph if possible. File No. 6477-V.

DEVELOPMENT ENGINEERING

Intermediate and Senior Professional Engineers, graduates in electrical engineering or engineering-physics, are needed for original, interesting work in the fields of navigational, nuclear, test and other instrument and control engineering, embracing transistor, radar, servo and computer techniques.

If you are interested in a position which offers scope for originality, initiative and technical competence above the average, please send me a detailed resume of your background, education and experience. All replies held in confidence.

Chief Engineer,
Sperry Gyroscope Company
of Canada, Ltd.,
P.O. Box 710, Montreal.

AN OPENING EXISTS for a graduate engineer, qualified for membership in the Association of Professional Engineers. Requires two to three years' experience in pressure vessel design, fabrication and inspection, and materials specification, and/or experience in metallurgy, metallography, and corrosion inspection. A sound knowledge of paints and protective coatings is highly desirable. Excellent company benefits and pension plan available. When replying, please develop qualifications and experience in full. Location Edmonton, Alberta. File No. 6485-V.

MECHANICAL or AGRICULTURAL ENGINEER. Agricultural Engineering Department of a well established University is seeking an alert and personable staff member. Duties to include taking full charge of Agricultural power and machinery classes for Agricultural Degree students, and also to give a course in Dairy Engineering. The latter course deals with the production and use of steam in a Dairy, some elementary electrical principles and applications, and principles of refrigeration. The desired staff member should be mature, responsible, and hold a satisfactory academic record. A man with some experience after graduation would be desirable. File No. 6491-V.

CIVIL ENGINEER with experience in construction or concrete, required by established manufacturer of construction chemicals in four Western Provinces. Preference given applicants now residing in West. Position involves contact with architects and engineers in support of distributors. All replies will be treated in confidence. Interviews can also be arranged in East. File No. 6492-V.

Maritime Professional Engineers Conference

The Program appears on Page 97 of this issue

September 2-5, 1958

Digby Pines, Digby, N.S.

MINUTES

(Continued on page 98)

Canadian Institute of Steel Construction, Montreal, Que.; and G. G. Meyerhof, M.E.I.C., Professor of Civil Engineering, Head of Department of Civil Engineering, Nova Scotia Technical College, Halifax, N.S.; for their paper, "Composite Construction of Bridges Using Steel and Concrete".

Leonard Medal—"For papers on mining subjects", to Professor E. O. Lilge, M.C.I.M., Department of Mining, University of Alberta, Edmonton, Alta.; for his paper, "Operating Variables of the Driessen Cone, Heavy Media Concentration".

Plummer Medal—"For papers on chemical and metallurgical subjects", to Dr. H. R. L. Streight, F.C.I.C., Principal Chemical Engineer, DuPont Company of Canada (1956) Ltd., Montreal, Que.; for his paper, "Air Pollution Control at a Nylon Intermediates Plant".

Ross Medal—"For papers on electrical engineering subjects", to Ronald George Griffith, M.E.I.C., Chief Engineer, Canadian Overseas Telecommunications Corp., Montreal, Que.; for his paper, "Recent Expansion of Canadian Overseas Telecommunications Facilities".

H. N. Ruttan Prize—"For the best paper presented by a Junior of the Institute in the Western Provinces", to Wilfred Pegusch, JR.E.I.C., Swan, Rhodes & Wooster, Vancouver, B.C.; for his paper, "Kelowna Floating Bridge".

John Galbraith Prize—"For the best paper presented by a Junior of the Institute in the Province of Ontario, to Charles Murray Stewart, JR.E.I.C., Mechanical Design Section, Engineering Division, Imperial Oil Limited, Sarnia, Ont.; for his paper, "Modernization of Halifax Refinery".

Phelps Johnson Prize—"For the best paper presented by an English Junior of the Institute in the Province of Quebec", to Donald Andrew Chamberlain, JR.E.I.C., Dominion Bridge Company Limited, Montreal, Que.; for his paper, "Prestressed Wind Bracing in Queen Elizabeth Hotel".

Ernest Marceau Prize—"For the best paper presented by a French Junior of the Institute in the Province of Quebec", to Gilles Gagnon, JR.E.I.C., McDougall, Smith & Fleming, Montreal, Que.; for his paper, "Etude sur la Circulation dans la Ville de Montreal".

Martin Murphy Prize—"For the best paper presented by a Junior of the Institute in the Atlantic Provinces", to Robert Donald Neill, JR.E.I.C., Design Department, New Brunswick Electric Power Comm., Fredericton, N.B.; for his paper, "The Selection of the Most Economical Steam Conditions for Central Station Generating Units".

Report of Council, Report of Finance Committee, Financial Statement and Treasurer's Report

The president announced that as Mr. Deschamps, the chairman of the Finance Committee had to return to Montreal, he was asking Dr. Solandt the treasurer to report for both officers.

Dr. Solandt reported that the Institute's activities for 1957 had been very satisfactory. He pointed out that the revenue was the highest on record but he noted also that expenses had increased substantially with the effect that the overall surplus was reduced.

He commented that some of the increased expenditure was due to normal inflation but the greater part came directly from increased activities and services to the members.

As far as the figures for the Institute assets are concerned he said this was an understatement of the real values inasmuch as the property itself was shown only at the assessed value instead of the real value.

During the year investments were handled by a special sub-committee in consultation with experts in the financial field. As a result some changes were made in the portfolio with considerable advantage to the Institute.

In summary, Dr. Solandt pointed out the financial situation of the Institute is very satisfactory. He asked the members to note, however, that income for *The Engineering Journal* from advertising, was being reduced noticeably. The outlook for the future is not as bright as it had been in the past. He felt he should warn the membership of that change. He felt that in the future "membership should look very carefully at proposals for new expenditures so that the money is spent as wisely as possible".

On the motion of E. D. Gray-Donald, seconded by M. P. Whelen, it was resolved that the report of Council, the report of the Finance Committee, the financial statement and the treasurer's report be accepted and approved.

Committee Reports

The president stated that before asking for approval of the committee reports he wanted to express on behalf of Council and the membership, appreciation of the splendid work done by the great number of chairmen and their committees. These people have carried on the business of the Institute extremely well—the burden of all the work, as usual, falling on the chairmen.

On the motion of Sydney Sillitoe, seconded by J. A. Watters, it was resolved that the reports of the following committees be taken as read and approved: Admissions, Board of Examiners, Life Members Committee, Professional Interests, Professional Development, Prairie Water Problems, Technical Operations, Property, Legislation, Library and House, Publication, Papers, Report of Field Secretary, Western Field Secretary, Library Report, Employment Service, Canadian Chamber of Commerce, Canadian Standards Association, Ontario Division.

Branch Reports

On behalf of the members of the Institute the president extended to the chairmen of branches, and the members of branch executives, appreciation for the wonderful work they had done throughout the year. He emphasized that these officers usually carry on the work of the branch at great inconvenience to themselves. However, their contribution to the life of the Institute was outstanding.

On the motion of H. L. Johnston, seconded by J. H. Racey, it was resolved that the reports of the branches be taken as read and approved.

Confederation

The president reported that the joint committee set up by the Engineering Institute of Canada and the Canadian Council of Professional Engineers had met at different times and at different places throughout the year—eventually a report had been presented to a special meeting of Council held on the previous Monday, May 19th. After a discussion which lasted many hours the meeting came to the unanimous approval of the following resolution:

> "That this plenary meeting of the Council of The Engineering Institute of Canada unanimously accepts, with appreciation, the report of its Committee on Confederation, its first seven clauses as a guide to further action, its eighth clause in principle but subject to further discussion with the other part of the joint committee, and the General Clauses as amended at its meeting earlier to-day; and the Council requests that the joint committee continue its work and prepare as quickly as is practicable a statement, embodying its report and the objectives of the new national body, for presentation to and balloting upon by the membership of the Institute and of the Associations and Corporation after approval by the respective Councils."

Election of Officers

The general secretary presented the list of the newly elected officers of the Institute as follows:

President

K. F. Tupper, Toronto, Ont.

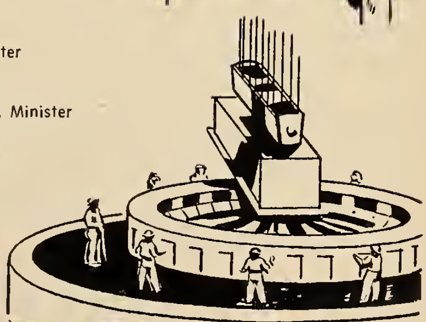
Vice-Presidents

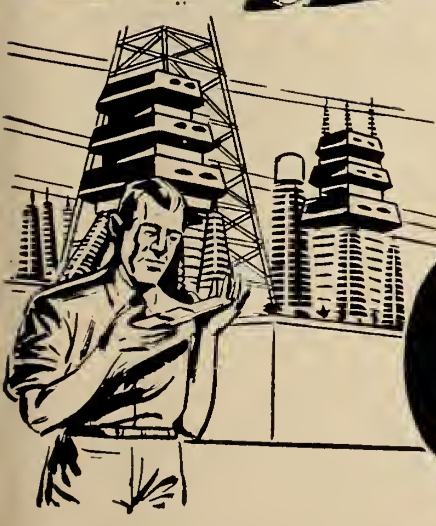
J. B. Angel, St. John's, Nfld.
E. T. Buchanan, Grand Mere, Que.
H. G. Conn, Kingston, Ont.

Councillors

Vancouver Branch, F. M. Cazalet.
Edmonton Branch, S. J. Hampton.
Lethbridge Branch, D. Cramer.
Calgary Branch, T. D. Stanley.
Saskatchewan Branch, Wm. M. Berry.
Winnipeg Branch, N. M. Hall.
Sault Ste. Marie Branch, W. D. Adams.
Northeastern Ontario Branch, A. A. Kidd.
Huronia Branch, E. L. Cavana.
Sarnia Branch, R. A. McGeachy.
Kitchener Branch, L. J. R. Sanders.
Hamilton Branch, E. T. W. Bailey.
Niagara Peninsula Branch, P. E. Buss.

(Continued on page 144)





MINUTES

(Continued from page 142)

Toronto Branch, E. R. Davis, M. P. Whelan.
Peterborough Branch, P. F. Peele.
Ottawa Branch, W. A. Capelle.
Cornwall Branch, H. E. Meadd.
Montreal Branch, E. D. Gray-Donald, J. E. Leo Roy.
Quebec Branch, B. O. Baker.
Northern New Brunswick Branch, Wm. S. Hosking.
Moncton Branch, A. W. Purdy.
North Nova Scotia Branch, R. S. Morrow.
Halifax Branch, G. F. Vail.
Cape Breton Branch, M. R. Campbell.

Vote of Thanks to Retiring Officers

Dr. Heartz proposed a vote of thanks to the retiring officers accompanying his resolution with the following remarks: "Gentlemen, I deeply appreciate the privilege and honour of expressing on your behalf our thanks to the retiring president and the officers. While this is usually looked upon as routine matter, it has, I think, this year a special touch of regret that you, Mr. President, and your splendid councillors and officers finally drop out of the picture for the time being. Thank you, Sir, and your group for having done an outstanding job of work. We would like to express to you our appreciation and recognition of all the stress and strain of all the work you have carried on throughout the year. While you are retiring officially I am sure you will appreciate that we want you to continue your interest in the Engineering Institute to help build it into a bigger, finer and still stronger organization. It gives me much pleasure to move, Sir, on behalf of those present and others throughout the country a hearty vote of thanks to you and your officers for their services throughout the year".

This was seconded by Dr. Ira P. Macnab, and carried with enthusiasm.

Dr. J. B. Stirling asked for the privilege of addressing the chair. He made the following remarks: "Mr. President and gentlemen—I think it is particularly fitting and appropriate that at this 72nd Annual Meeting of the Institute we go on record as expressing our deep appreciation of the services of one of the most outstanding officers the Institute has ever had in its employment—that is the retiring secretary, Leslie Austin Wright. Coupled with these remarks I would like to add as part of this resolution that the Institute regrets extremely the necessity of his retirement. We certainly hope that his interest will not be lost as we desire that he shall continue to work for the Institute. Mr. President, it is difficult under the circumstances to express precisely what I feel and I do not wish to add further to Dr. Wright's embarrassment, but I would like to see it placed on the record that we appreciate deeply the work that Dr. Wright has done for us and we regret his retirement". This motion was seconded by George Schneider, with applause and a standing salute.

The meeting was adjourned at 11.30 A.M.

REPORT TO THE MEMBERS

(Continued from page 96)

the members of a branch. Unfortunately the Institute has grown to a point where it is almost impossible for a president, during the one year he is in office, to visit all branches.

The practice heretofore, of the General Secretary accompanying the President on branch visits, has proved most convenient for the President, yet it does mean that two of the principal officers are visiting the branch at one and the same time, and that some branches are not even afforded any contact. I suggest the possibility that the visit of the president and general secretary to branches might be divided, to an extent so that every branch will be visited at least once each year, and insofar as it is possible the branch receive two visits each year. The possibility of having the immediate past president, during the year immediately following his term of office, visit such branches as he was unable to visit during his presidency, might be well worth investigating.

The services of the assistant secretaries could be perhaps used to greater advantage by having them attend branch business meetings.

These suggestions are advanced as a result of the impressions I have received, that closer liaison must be established between the branches and headquarters.

At this point may I publicly acknowledge my depth of gratitude to the general secretary, to Miss McLaren and the other members of the staff of the Institute, who gave of their time and effort unstintingly towards advancing the interest of the Institute and making the president's term of office a year never to be forgotten. May I also thank the branch officers, the members of the branches and their good ladies for their many courtesies to Mrs. Anson and me throughout the year. We have met most interesting people, we have made many friends. We are looking forward to renewing those friendships from year to year.

In closing, let me again express to you, members of the Institute, my fond gratitude for the honour you extended to me, by permitting me to enjoy the office of president of the Institute during the past year. It is a privilege extended to few men and one which I prize beyond any other honour that has been accorded me. You can be assured that my services will always be available to the Institute in any manner in which they can be used. I shall never be able to repay you.

Thanks to You All

Life is full of changes, but one of the greatest is that which takes place when a person retires from a post which he has occupied and enjoyed for many years. This truth is just recently borne in on me.

Retirement is a natural development and one to be looked forward to with pleasurable anticipation. This I have done for several years and therefore have prepared myself for it, but the one thing that has been unforeseen by me has been the way in which my many friends and associates have greeted me on reaching this important turning point in my life. As I said at the Annual Meeting "I am 'flabbergasted'!" by it all.

It is not easy or perhaps even possible to thank adequately all the people for all they have done, but I do want to make a try. Such a great number of members participated in the project promoted by the president that it is impossible to write them individually. Hence I hope they will accept this as a manifestation of my appreciation. It is wonderful to know that so many people within the Institute cared enough to take part in the proposal to present me with a "souvenir" or "memorial". I am deeply touched.

The beautiful camera with all its "gear" will be a close companion for the rest of my life, and I hope that in one way or another, at one time or another, I may catch each one of you within its perfect lenses.

L. Austin Wright

Plant Visits for Nigerian Students

On behalf of the Nigerian Liaison Office at Washington, and of McGill University, the Engineering Institute of Canada is arranging an itinerary of visits for a group of 3rd year Nigerian Engineering students at McGill to industries and projects in Canada during this summer.

Nigeria expects to be granted its independence next year. Recalling the difficulties confronting Ghana recently on attaining nationhood, in creating its own civil service on short notice, the Nigerian Government is determined to educate and train a nucleus of its young men and women ready to take over civil service posts in science, medicine, arts and education. The Institute, in cooperation with McGill authorities, has prepared a list of construction projects to be visited of every type the students may encounter in their own country. Inspection will be made of many Canadian industrial plants whose production is based on raw materials similar to those found in Nigeria, or whose end products if imported by Nigeria may require maintenance there.

In addition, visits are being planned to the National Research Council laboratories, the Meteorology Branch of the Department of Transport, the Mines Branch of the Department of Mines and Technical Services, the Central Mortgage and Housing Corporation, the Photographic Survey Corporation, and the Canadian Pacific Railway electronic computer. A two-day tour of the Seaway will be made and if time permits a number of mining developments will be included.

Arrangements for visits within the Montreal area are being made by E.I.C. headquarters direct with the plants and projects concerned. Establishments in other provinces are being contacted by correspondence, and the assistance of chairmen of Branches of the Institute is being enlisted to coordinate the arrangements locally.

The student group members are supplied with funds by the Nigerian Government, and apart from advance arrangements for living accommodation by McGill authorities, and letters of introduction, they will be self conducted. The wholehearted cooperation of executives and staffs of both industries and government services so far contacted has been most gratifying.

Elections and Transfers

On the recommendation of the Admissions Committee the following elections and transfers were effected at the meeting of Council on May 23, 1958:

Members: R. Bonnaud, Montreal; T. S. Brandon, Shawinigan; J. Y. Essayan, Montreal; D. C. Leavitt, Toronto; A. R. Le Feuvre, Waterloo, Ont.; N. W. McGuinness, London; G. M. McHenry, London; F. E. Miller, Toronto; E. F. Pariset, Montreal; H. A. Price, Penticton; D. P. Ryan, Toronto; G. Sebastyan-Yishai, Ann Arbor, Mich.; G. Sfaellos, Montreal; E. Shaw, England; D. W. Urquhart, Montreal; F. E. Vuia, Montreal; T. J. Walsh, Sudbury.

Juniors: R. G. Blair, Winnipeg; J. E. Goulet, Chicoutimi; D. R. T. Marshall, Calgary; W. D .West, Toronto.

Junior to Member: A. J. Barker, Windsor; J. Bourbeau, Montreal; J. E. Knecht, Whitby; E. J. Lockwood, Vancouver; R. W. Lowe, Philadelphia; E. P. Mascarin, Walkerville; R. M. Moore, Sudbury; J. E. Sinnott, Walkerville; J. Zowtiak, Edmonton.

Student to Junior: S. D. Curran, St. Catharines.

STUDENTS ADMITTED

Loyola College: E. Batiuk; J. P. C. Fortin; M. B. Kelly; G. W. Labelle; J. G. McQuade; F. G. Montelpare; J. N. C. Nagy; M. P. Shinners; K. F. Sloan; J. Sopko.

University of Toronto: W. R. Cooper; C. M. King; W. Kostiw; G. D. Lynch; H. E. Seegmiller; W. J. Simpson.

St. Francis Xavier University: G. F. Farmer; R. L. MacKinnon; R. J. Pitre; R. D. Richard.

University of New Brunswick: J. F. Gronan; S. Rubin; W. A. Stothart.

McGill University: P. J. F. Rolf; P. H. Savard; R. M. Southey.

University of Alberta: M. B. Morin.

Nova Scotia Technical College: A. G. Melanson.

University of British Columbia: R. F. Jefferies.

Royal Military College: R. D. Hall.

Ontario Agricultural College: F. J. Brown.

Michigan College of Mining and Technology: K. T. Desai.

C.P.E.Q. Student: M. S. Fleiszer.

Applications Through Association

By virtue of the co-operative agreements between the Institute and the Association of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members: D. W. Purdy; **Juniors:** J. N. Bowersock; G. G. Jacox; **Junior to Member:** P. J. Dowling; **Student to Junior:** G. R. McDonagh.

SASKATCHEWAN

Members: S. L. Ashley; D. Bradwell; H. C. Daugherty; G. E. Drysdale; F. A. Gerard; F. M. Hewitt; A. G. Kennedy; B. K. Smith; J. H. Smith; **Junior:** H. Lee; **Students:** D. D. Baldwin; L. A. Brown; D. L. T .Chapman; R. G. Martin; R. G. McIntosh; S. R. Meek; B. J. Pannell; D. G. Perkins; B. G. Rosser; W. Shtenko; V. M. Strijack; R. J. J. Trudel; P. E. Walsh; **Junior to Member:** H. K. Bowers; N. A. Meneley; L. H. Sawatsky; Z. E. Wasarab; **Student to Junior:** D E. Cherry; D. V. Gilewich; G .B. Lipsett; L. Morrison; K. C. G. Pritchard.

NOVA SCOTIA

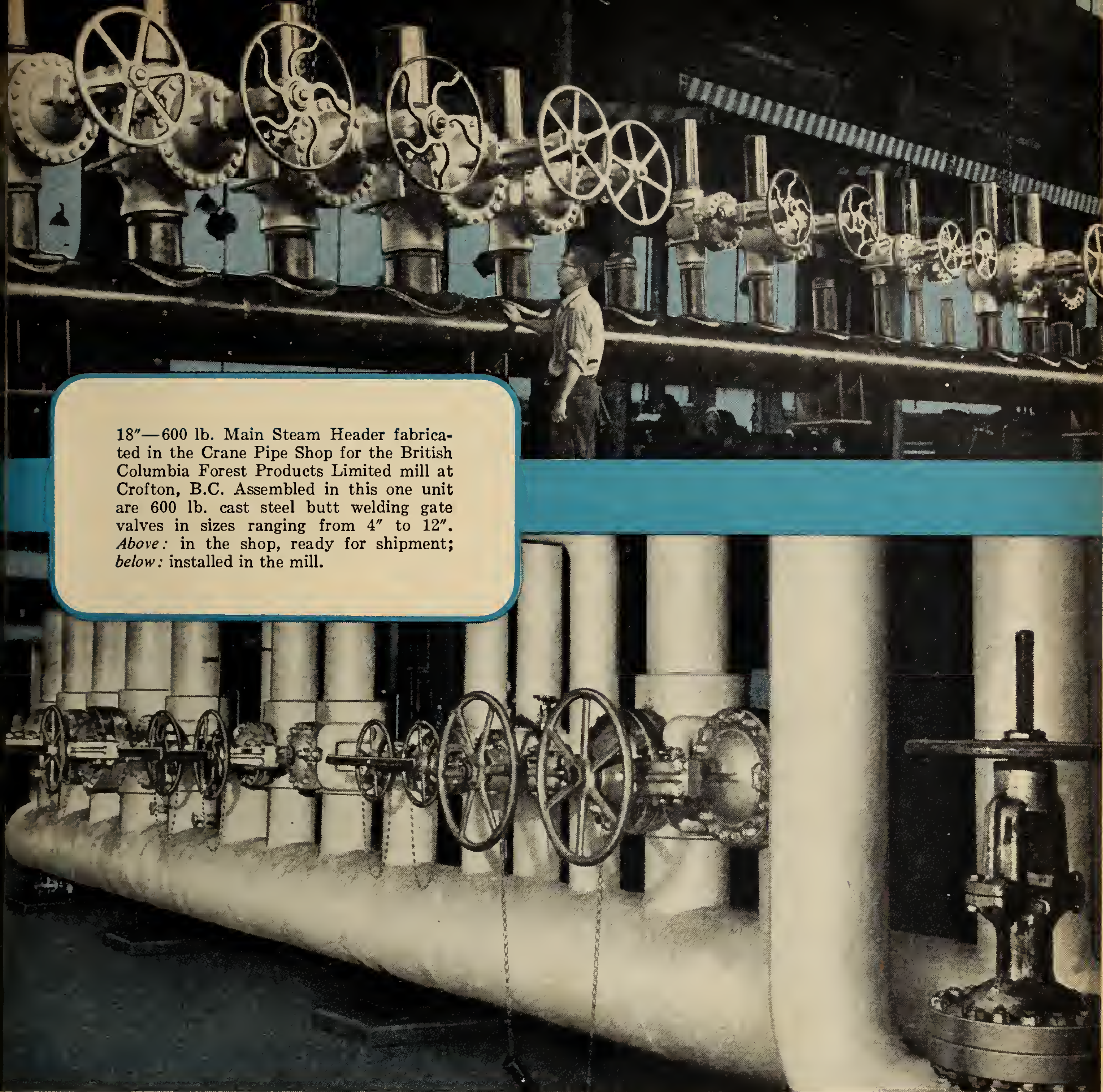
Members: G A. Blackman; A. T. Kosacz; J. W. Mason; J. F. Miles.

NEW BRUNSWICK

Junior to Member: L. R. Ward.

PRINCE EDWARD ISLAND

Member: M. B. Lodge.



18″—600 lb. Main Steam Header fabricated in the Crane Pipe Shop for the British Columbia Forest Products Limited mill at Crofton, B.C. Assembled in this one unit are 600 lb. cast steel butt welding gate valves in sizes ranging from 4″ to 12″. *Above:* in the shop, ready for shipment; *below:* installed in the mill.

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Unit fabrication in the CRANE PIPE SHOP *saves you time and money, avoids trouble. You get a* complete *unit built precisely to applicable codes, and to your drawings and specifications—and* pre-tested *before being shipped to the job. Contact your local Crane Branch.*

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Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

Foundation Company Appointments — L. J. McGowan has recently been elected president of The Foundation Company of Canada Limited succeeding F. G. Rutley, M.E.I.C., who has been elected chairman of the board. Further executive appointments: R. F. Shaw, M.E.I.C., executive vice-president; R. E. Chadwick (former chairman), consulting engineer; W. E. Hickey, M.E.I.C., vice-president and chief engineer; F. W. Maund and L. H. Rowe, vice-presidents. Changes in subsidiary companies include the appointment of J. P. Lockett as vice-president and general manager, The Foundation Company of Ontario Limited; A. G. Sullivan, president and general manager, Foundation Maritime Limited; Per Hall, president, Foundation of Canada Engineering Corporation (F. G. Rutley becomes board chairman).

Canadian Utilities—The following executive officers were recently appointed by Canadian Utilities Limited: H. R. Milner, chairman; J. C. Dale, M.E.I.C., president and general manager; F. A. Smith, vice-president finance; K. L. MacFayden, comptroller; A. M. Anderson, assistant comptroller; T. A. Montgomery, secretary; A. M. Irvine, treasurer and assistant secretary; H. Brown, assistant treasurer.

R. A. Reid

Ferranti-Packard — T. Edmondson has been appointed president and chief executive officer of Ferranti-Packard Company Limited, Toronto, which has been formed to consolidate operations of Ferranti Electric Limited, Toronto, and Packard Electric Company Limited, St. Catharines, Ont. Other executive appointments are: J. M. Thomson, chairman, board of directors; J. Fogarty, vice-president and general manager, electronics and ordnance division, Toronto; W. L. Hetherington, M.E.I.C., vice-president and general manager, power transformer division, Toronto; D. F. Martin, vice-president and general sales manager, marketing division; G. L. Murray, vice-president and general manager, distribution transformer and metering equipment division, St. Catharines; H. S. Wigley, vice-president and controller.

Canadian Westinghouse — Announcement has been made of the appointment of H. Thomasson as consulting engineer for Canadian Westinghouse Company Limited, Hamilton, Ont.; Mr. Thomasson has recently been awarded a life-membership in the Canadian Welding Society. Other appointments announced: M. J. Lavigne, manager, metallurgical-mechanical section of the Canadian Westinghouse research and development laboratory, and W. E. McBride, manager, union relations.

New Treasurer—Announcement has been made of the appointment of J. F. Kidner as treasurer of Canadian Oil Companies Ltd., Toronto, succeeding C. W. Walker, who is retiring after 45 years' service.

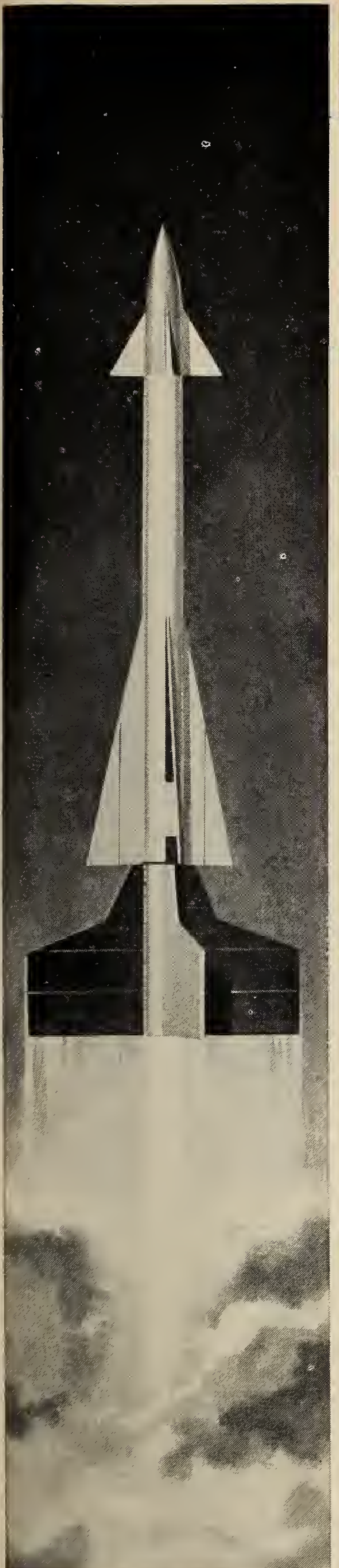
L. J. McGowan

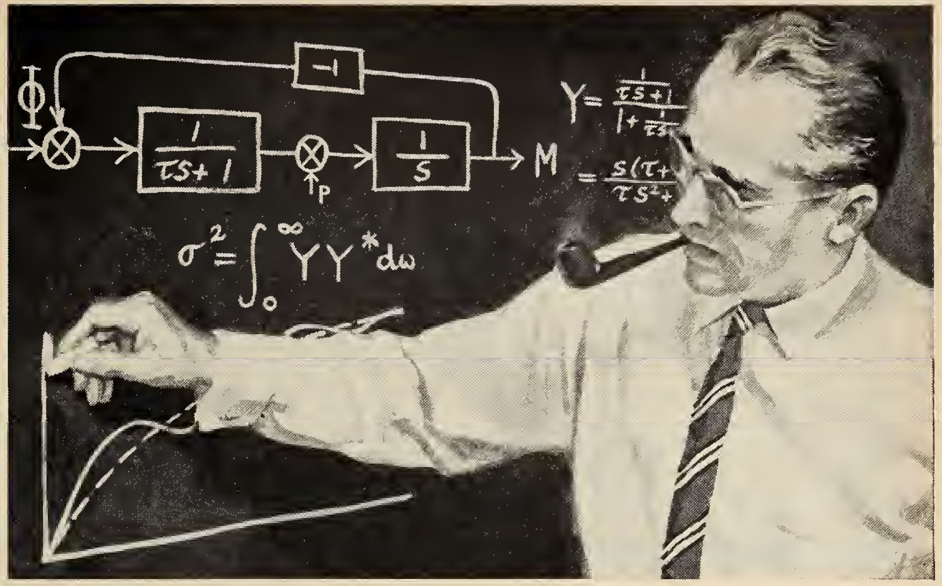
Dominion Bridge—R. A. Reid has been appointed to the newly created position of manager of the Winnipeg branch of the Dominion Bridge Company Limited. Mr. Reid, formerly works manager at Winnipeg, will be succeeded by M. J. Lyons.

C-I-L Sales Appointments—J. J. F. Smith has been made Quebec district sales manager in the explosives division of Canadian Industries Limited, replacing J. C. Lowrey, who has retired. Also announced is the appointment of L. J. Lagimodiere as manager construction sales of the explosives division, with headquarters in Montreal.

Neptune Meters Promotion — R. M. James, formerly sales agent in Southwestern Ontario, has been promoted to the position of manager of the Vancouver office of Neptune Meters Ltd.

American-Standard—H. Adams has been named works manager in charge of manufacturing operations for American-Standard Products (Canada) Ltd., Toronto. P. Britton succeeds Mr. Adams as





• BRIEFS

manager of the company's Sirocco plant in Windsor, Ont.

Field Aviation Company—The following appointments have recently become effective at Field Aviation Company Limited: R. J. Quigley, manager, aircraft sales division, and R. E. McCullough, manager, maintenance hangarage operations at Calgary, Alta.

Senior Geologist — Hunting Technical and Exploration Services Ltd., Toronto, has recently announced the appointment of N. Hogg as senior geologist for the organization.

Recent Appointments — Following a realignment of the sales districts of J. A. Wilson Lighting and Display Ltd., K. R. Meyrick has been appointed Ontario district sales manager, and A. J. Cahill, assistant sales manager for the district.

Du Pont Plastics Division—The following appointments have been made in the recently organized plastics division of Du Pont Company of Canada (1956) Limited: R. P. Eyres, Toronto district sales manager; R. D. Tillotson, sales representative, Toronto; P. E. Quesnel, sales representative, Montreal.

Canadian Liquid Air — The appointment of two sales supervisors has recently been announced by Canadian Liquid Air Company Ltd.: G. W. Gaboury, for the central Quebec Province district, and G. Reeve for the Lakehead area.

News of Business and Industry

Nationwide Tribute to Tool Engineering — North American Van Lines, Inc., Fort Wayne, Indiana, recently sponsored a very interesting program on machine tool engineering when a report on this subject was presented by A. Dreier in their NBC-Monitor show "America on the Go."

New Premises — E.C.C. Canada Limited has recently moved to newly constructed premises at 66 Colville Road, Toronto 15, where standard products and spare parts are available for immediate service. The company is responsible for the consultation, sales and distribution services of the products of its English principals, The Electric Construction Company Limited and George Ellison Limited. The products include rotating machines, rectifiers, transformers, high and medium voltage switchgear, automatic and hand-operated motor control gear, hydraulic valves and "Tufnol", a material used for a wide variety of engineering components.

New Plant — A new Canadian company, Link-Belt Speeder (Canada) Ltd., has commenced construction of a plant in Woodstock, Ont. to manufacture power cranes, shovels and draglines. The new company is a subsidiary of Link-Belt Speeder Corporation of Cedar Rapids, Iowa, manufacturer of power shovel-cranes. The plant will be constructed on a 39-acre site and will consist of two crane bays comprising some 32,000 sq. ft. of space. It has been designed so that it may become the first section of a larger, fully integrated plant when future expansion is required.

Standard Steel Framed Buildings — Sanders & Forster Ltd., a member of the Chamberlain Group of Companies, of London, England, designers and manufacturers of S & F standard buildings, have now designed three buildings within this range to conform with the special requirements of the Canadian and Scandinavian areas. Using a tied portal frame as the basis of design, a "Superload" building has been developed which has the clean lines of a rigid portal frame and uses less steel than the conventional truss and stanchion type of structure.

Record Size Single Compartment Ball Mill — The biggest single compartment ball mill built in the United States — a 13 by 20 ft. unit — has been shipped to a midwestern cement plant by Allis-Chalmers. Because of its unusual size, the ball mill had to be shipped in two pieces set sidewise on the car and then reassembled at the erection site. Along with the huge ball mill, which is expected to be in operation by summer, Allis-Chalmers is supplying this installation with a 2000 h.p. motor and control equipment. The motor is designed to operate at the slow speed of 180 r.p.m. at 2300 volts as a wound rotor type as it starts up and as a synchronous motor when it is well underway. In this manner, low starting current and high torque get the big mill turning without a major drain on the power system.

Magnet Wire Plant — A 113,000 sq. ft. magnet wire division plant of Canada Wire and Cable Company Limited has

recently been put into operation at Simcoe, Ont. This automatically-operated factory for producing all sizes of enamelled and textile-covered magnet wire is located on 13½ acres of ground and is centrally-located to supply by road or rail the principal markets of magnet wires in Toronto, Hamilton and St. Catharines as well as throughout Canada. This is Canada Wire's sixth plant, the others being located at the head office in Toronto, Montreal East, Smith Falls, Ont., Fort Garry, Man., Annacis Island near New Westminster, B.C., and now Simcoe.

New Distributor — The appointment of Midwest Mining Supplies Limited of Winnipeg as sole G.M. diesel distributor in Manitoba has been announced by General Motors Diesel Limited, London, Ont. The new distributor is responsible for the sale of G.M. industrial and marine diesel engines and factory-engineered parts as well as service. Their servicemen perform free on-the-site inspections and tune-ups on new G.M. diesel engines. They also provide operator instruction and information on preventative maintenance procedures. Midwest Mining Supplies Limited bring to 45 the number of G.M. Diesel distributors and dealers across Canada.

Consultants Firm — The Warnock Hersey Company Ltd., has recently announced the formation of Warnock Hersey Management Consultants Ltd. to consolidate and expand the management consulting services of the firm: Montreal office — 128 Elmslie St., HU. 1-0351; Toronto office — 600 Sherbourne St., WA. 4-9691.

Epoxy-Type Resins — The first Canadian plant to produce epoxy-type resins went into production recently at Montreal East. The Shell Oil Company of Canada built the $1 million plant adjacent to its other chemical manufacturing facilities in that community. The company claims that the capacity of the new plant is sufficient to supply Canada's demands for these relatively new products. Shell of Canada has marketed epoxy resins in this country for a number of years under the trademark EPON, importing them from Shell Chemical Corp. in the United States. Since their introduction, Epon resins have set new standards for the surface coating industry due to their unique combination of adhesion, chemical resistance and flexibility. In addition to their wide use in the surface coating industry, Epon resins are also used in adhesives for the aviation industry and in laminates and castings for electrical uses.

DISCUSSION *(continued from page 84)*

FORCES INVOLVED IN PULPWOOD HOLDING GROUNDS:

The Engineering Journal, January, 1958.

1941 and 1950 to give a 5-month log towing season. The canyon is the end of boat navigation.

Possibilities of river transportation directed attention to the large volume of timber within trucking distance of the canyon. Railways and highways provided access to the canyon but it was not economical to move logs by this method to coast mills.

No operator was prepared to risk driving individual logs as there was no apparent place where a holding ground for individual logs could be installed without interfering with navigation.

The method finally used was to truck the logs to the river, place three wire rope straps around the load and dump in the river. This formed a bundle of 10 to 12 wide, 40 ft. log averaging 8 M f.b.m. (16 cords). These bundles travelled down river without damage and were caught at the lower end of the canyon by river boats, boomed and towed to coast mills.

In 1955 a holding ground was constructed in a section of the river where one boat could guide bundles to the entrance of the holding ground.

Since 1952, 50 million f.b.m. (100,000 cords) have been bundle driven for distances up to 180 miles with no expenditure for channel improvements. Bundles generally travel in the main current and pass backwaters that will catch individual logs. Bundles caught by falling water clear on high water the following year.

The disadvantage to bundle driving compared to individual log driving is the cost of wire or steel strapping and the need for 6 to 8 ft. of water in the river channel.

The advantages of bundle driving over individual log driving as they apply to B.C. are:

(1) Bundles can be held on lakes and rivers waiting for high water with less danger of loss from sinkage, wind and waves.

(2) When river conditions are favourable bundles will float in the main channel and clear backwaters and where the river is navigable can be guided by river boats.

(3) Holding grounds tended by river boats can catch bundles without catching driftwood or interfering with navigation.

(4) If bundles pass the holding ground the owner can easily identify his logs and salvage while afloat.

Bundle driving is a possible method of transporting logs on several large British Columbia rivers emptying into lakes or salt water where it is necessary to move timber long distances to mills. It may be applicable to other Canadian rivers where limited timber volumes or other conditions make this cheaper than driving individual logs or hauling by truck or railroad.

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Current Events

Professional Affairs

Employment and Business

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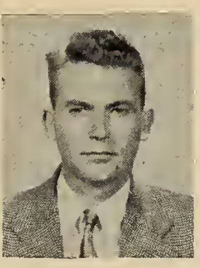
MEMBERSHIP

Indexed in The Engineering Index

(19,200 copies of this issue printed)

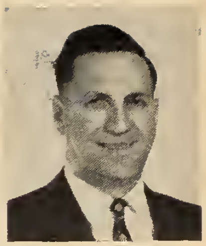
MEET THE AUTHORS

D. C. Rose, M.E.I.C., Principal Research Officer, National Research Council, Ottawa, Ont. *(The International Geophysical Year.)* A graduate of Queen's University, Kingston, (B.Sc., 1923; M.Sc., 1924), Dr. Rose obtained his Ph.D. from Cambridge University in 1927. He has been a member of the National Research Council staff since 1930, and is at present in charge of research on cosmic rays; during World War II he was on loan for five years to the Department of National Defence. Dr. Rose is chairman of the Canadian National Committee for the International Geophysical Year.



R. F. Chinnick, Superintendent, Electronics Wing, Canadian Armament Research and Development Establishment, Quebec, Que. *(The CARDE I.G.Y. Upper Air Research Program.)* Mr. Chinnick is an engineering graduate of Queen's University, Kingston, (B.Sc., electrical, 1943), and obtained his M.Sc., physics, from the University of Toronto in 1946. Since 1950 he has been employed by CARDE on electronics associated with missiles, missile ranges and research.

F. R. Park, Senior Research Officer, Upper Atmosphere Research Section, National Research Council, Ottawa, Ont. *(An Observatory for the Study of Meteors.)* Graduating from the University of Alberta (B.Sc., electrical engineering, 1936), Mr. Park joined the radio division of N.R.C. in 1941 after a period in industry and other government service. During the war he served as project engineer of several naval radar projects, and from the end of the war until 1956 was head of the civil radar development section, N.R.C. Mr. Park is a senior member of the Institute of Radio Engineers, and a life member of the Royal Astronomical Society of Canada.



D. R. Graham, M.E.I.C., Waterworks Engineer, City of Saskatoon, Saskatoon, Sask. *(Tunnelling Saskatoon's 14th Street Storm Sewer.)* Mr. Graham graduated from the University of Saskatchewan in mechanical engineering in 1947, after which he spent a year on waterworks construction and three years as maintenance supervisor, Saskatoon Transit System; he was in charge of the 14th Street storm sewer project for the major part of its construction. Mr. Graham has held his present position for the past five years and is now in charge of the waterworks utility.

N. L. Iverson, M.E.I.C., P.F.R.A. Engineer, Department of Agriculture, Saskatoon, Sask. *(Tunnelling Saskatoon's 14th Street Storm Sewer.)* Mr. Iverson graduated from the University of Saskatchewan, civil engineering, in 1945, and spent one year with the Standard Fruit and Steamship Company in Honduras. Since that time he has been employed with the Prairie Farm Rehabilitation Administration, primarily in design and construction of earth dams and pertinent works. He was engaged on consulting and testing of soil samples on the 14th Street storm sewer project.

R. G. Gustavson. *(Education for Tomorrow.)* Dr. Gustavson (doctor's degree in chemistry, U. of Chicago, 1925) taught chemistry at a number of institutions; he became dean of the graduate school of the University of Colorado, and later president of the university. Subsequently he went to the University of Chicago as vice-president and dean of faculties. Dr. Gustavson served for five years on the Board of Governors of the Argonne National Laboratories, whence he went to the University of Nebraska as chancellor, and from there to his present position which is that of president and executive director of Resources for the Future, Inc. This is an organization supported by the Ford Foundation; (their primary interests are making economic studies in connection with research, such as energy, land ease and management, water sheds and river basing and regional development.)

COVER PICTURE

Part of the International Geophysical Year program consists of investigations of the upper atmosphere by means of instrument-carrying rockets. The Canadian Armament Research and Development Establishment is taking part in a joint rocket program with the United States at Fort Churchill, Manitoba, where instrumentation and communication facilities have been installed. The work is described in an article on page 61. The picture shows an Aerobee rocket after firing, with some of the radio telemetering equipment.

Official U.S. Army Photograph

The International Geophysical Year

D. C. Rose, M.E.I.C. *Division of Pure Physics, National Research Council*

Chairman of the Canadian National Committee for the International Geophysical Year

Read at the 72nd Annual General and Professional Meeting of the Engineering Institute of Canada, Quebec City, May 1958

THE INTERNATIONAL Geophysical Year (July 1, 1957 to December 31, 1958) was organized because experience has shown the advantage of a concentrated effort in attempting to realize a better understanding of the physical laws of nature. This applies particularly in geophysics where the objective requires measurements all over the surface of the earth. The objective in this case is a study of the physics of the earth and its immediate environment. Although we are in much closer contact with the earth than any other part of the universe, that very contact makes it difficult to study this planet as a whole. We know much more about the thin layer on its surface to which we are confined (at least for the present) than we do about any other planet but there has always been a desire to look at it from some distance away. There are also large gaps in a complete understanding of things with which we are reasonably familiar such as for example the circulation of the atmosphere and the complete radiation spectrum of the sun.

To the geophysicist who is interested in the planet as such, the earth is not solid firmament but a dynamic mass continuously undergoing change. It has a hot and probably liquid core. Thermal and material movements in the core influenced by the earth's rotation result in the generation of a very interesting magnetic field. The surface is constantly changing. Ice ages on the surface come and go. Continental areas move and rise and fall. Cracks and folds make mountain ranges which are eroded away by the action of a very dynamic atmosphere.

Fortunately, in the life of man these changes are very slow but it would be nice to know more about them. The energy exchanges are tremendous. A good sized hurricane has more energy than an atomic bomb and the energy released in a large earthquake makes even the largest hydrogen bomb look trivial.

To study these things, data are required all over the surface of the earth. Data over a limited region are of little use to anyone and there is so much to be learned that the need for exchange of information breaks down political barriers and international jealousy. This makes it much easier to organize a cooperative scientific project such as the International Geophysical Year than it is to solve some of the problems of the United Nations.

This is the third effort of this type. The first two were in 1882-83 and in 1932-33. They were known as International Polar Years. The objective back in 1882-83 was to learn more about such geophysical problems as air circulation, the occurrence of the aurora, geomagnetism, and atmospheric electricity in the comparatively unexplored parts of the world. It was realized that exploration merely for the sake of exploration without taking scientific measurements could be of no particular value. Further, the joint concentration of effort by interested groups whose individual facilities were limited produced results far greater than the proportional increase in numbers.

There were three expeditions into Northern Canada in the 1882-83 International Polar Year. One of them was partially financed by the Canadian Government, that was a British expedition to Fort Rae not far from the now thriving town of Yellowknife. A German expedition went to Kingua Fiord in Cumberland Sound, a little over a hundred miles north of the growing town of Frobisher on Baffin Island. An American expedition studied the coasts of Greenland and Ellesmere Island. This expedition discovered Hazen Lake in Northern Ellesmere Island where a party is

The International Geophysical Year (July 1, 1957 to December 31, 1958) is an effort on the part of geophysicists to pool their resources in studying the physics of the earth, particularly in regard to problems which require simultaneous or synoptic measurements over the whole surface of the earth. Two previous similar efforts in 1882-83 and 1932-33 were limited to polar regions and were called "International Polar Years". In the present paper the history and organization of the project is presented briefly. In each of the fourteen different disciplines (fifteen in the Canadian program) the highlights of the scientific objectives are presented with a description of the Canadian Program. The different disciplines are: I World Days, II Meteorology, III Geomagnetism, IV Aurora and Airglow, V Ionosphere Physics, VI Solar Activity, VII Cosmic Rays, VIII Latitudes and Longitudes, IX Glaciology, X Oceanography, XI Rockets and Satellites, XII Seismology, XIII Gravity, XIV Nuclear Radiation, XV Meteor Studies.

now studying the glaciation of that area.

During the second International Polar Year there were six special expeditions in Northern Canada and the network of meteorological stations in existence then contributed to the program. One of these expeditions was British the rest Canadian. The British group was again at Fort Rae. Canadian groups worked at Cape Hopes Advance, Chesterfield Inlet, Coppermine, Meanook, and Saskatoon. Some of the Canadian scientists who took part in these expeditions are now playing an active role in this International Geophysical Year. Fig. 1 is a map showing the location of these stations.

Our Canadian program this year lists eighty stations taking measurements in Canada. Only two or three of these were established because of the I.G.Y. The rest are in existing laboratories, at weather stations or similar outposts which have been extended right to our most northerly land during the last twenty-five years' growth. Fig. 2 is a map showing the location of the 1957-58 stations. When the suggestion was put to us about six years ago that a third International Polar Year be organized there was not much enthusiasm among the Canadian scientists concerned because we felt we were pretty well extended into Arctic regions. The change from polar to world-wide objective raised our enthusiasm considerably and the whole program has had a very wide popular appeal.

THE INTERNATIONAL ORGANIZATION

The I.G.Y. has been organized under the supervision of the International Council of Scientific Unions. This is a body made up of representatives from the various International Scientific Unions. An International Committee was formed about five years ago known as the Comité Special de l'Année Geophysique Internationale (C.S.A.G.I.). This Committee was formed by selected representatives from nine International Scientific Unions concerned with geophysical problems. There is an Advisory Council to C.S.A.G.I. which may have representatives from all countries taking part in the organization. About seventy countries have formed national committees. The C.S.A.G.I. and the Advisory Council meet together once a year and a number of delegates attend so that working groups can be formed in the various branches of the program.

A bureau is maintained at Uccle, Belgium, under the direction of Dr. M. Nicolet, the secretary general of C.S.A.G.I. This bureau acts as an information headquarters for the distribution of the instruction manuals and other publications prepared by the working committees and the organization of data centres. The bureau itself has five senior officers, one of whom is the coordinator.

In Canada the organization grew out of two National Research Council Associate Committees: one on Radio Science and one on Geodesy and Geophysics. The former is the Canadian National Committee of the International Radio Science Union and the latter the Canadian Committee of the International Union of Geodesy and Geophysics which held its Eleventh General Assembly in Toronto in August 1957. A Canadian National I.G.Y. Committee was organized in 1953, under the chairmanship of F. T. Davies, Assistant Chief Scientist, Defence Research Board. Mr. Davies had both Arctic and Antarctic experience having been a member of the first Byrd Expedition to Antarctica and the leader of the Canadian expedition to Chesterfield Inlet in 1932-33. This Committee drew up a preliminary program which was adopted in 1955. The problem in planning the program was one of selecting projects that could be undertaken rather than the planning of an ideal program. The amount of geophysical research to be done in Northern Canada is prodigious, as may be gathered from the outline of the objectives in the various subject headings in this paper. We can only hope to tackle a little year by year and the objective in the I.G.Y. program was to direct our efforts along the lines that fitted the international plans as closely as possible, by expanding our efforts as far as finances and the availability of trained personnel would permit.

When the preliminary plans were adopted and the time for action approached a small I.G.Y. Coordinating Committee was formed consisting of C. S. Beals, the Dominion Astronomer; F. T. Davies; D. W. R. McKinley and D. C. Rose, of the National Research Council. D. C. Rose was named chairman of this committee and a small coordinating headquarters was established in the Division of Pure Physics in the National Research Council. The Canadian organization is largely decentralized. This was convenient because there is one natural headquarters for each of the disciplines, either in a Government laboratory or in a university. This decentralization meant

Fig. 1. Map of Canada showing the stations especially established for the 1932-33 International Polar Year. Meteorological stations which also contributed are not included.

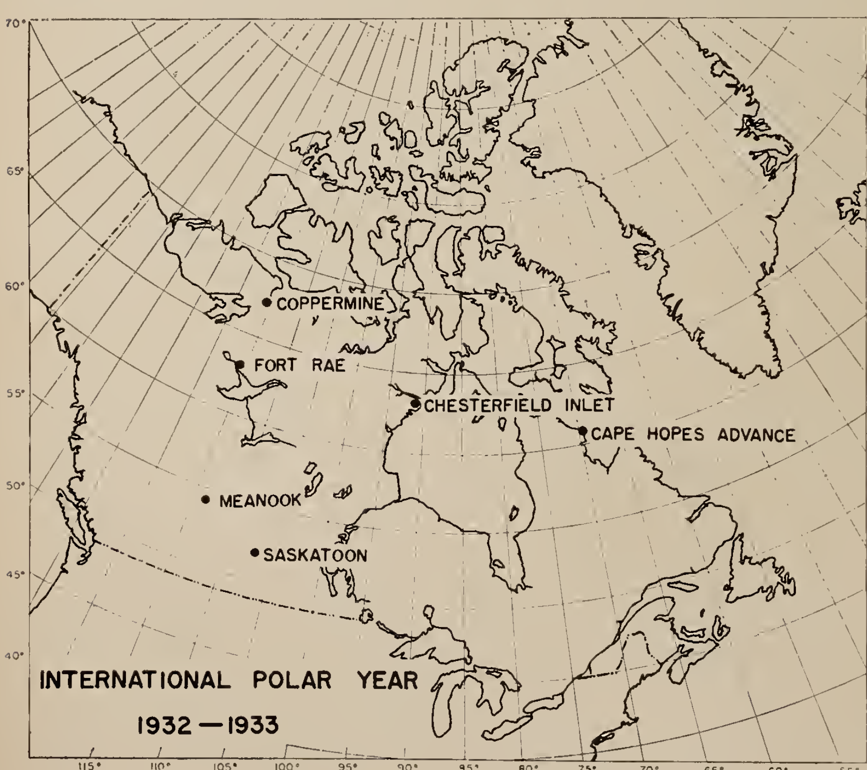


Fig. 2. Map of Canada showing stations included in the 1957-58 International Geophysical Year Program. The location of measurements in the various disciplines is shown.

that only a small headquarters was necessary and W. F. Mahoney, Administrative Officer of the National Research Council was appointed secretary of both committees. Financing of the projects is handled through the normal channels in the Government departments and by assisted research grants from the N.R.C. to universities. In 1957 Mr. Davies withdrew from the chairmanship of the larger National Committee and D. C. Rose was elected in his place.

In the international planning it was seen at an early stage that objectives must be limited to those that require synoptic or simultaneous measurements over the whole surface of the earth for their solution. There are so many problems of this type that any projects of local interest only could not be accepted as part of the I.G.Y. Another point that is of interest in this regard is that no project accepted as part of the I.G.Y. program has security classification of any sort. Although the armed services of many countries are making a large contribution to the plan any project undertaken as part of the program is unclassified and it is fully anticipated that the resulting data will be freely exchanged.

The international program is divided into fourteen separate disciplines, fifteen in the Canadian program. These are the natural subdivisions of geophysical research with the addition of "World Days" and "Rockets and Satellites". The former is included as a discipline because a working committee was formed parallel to the others and the communication problems involved made it a very important part of the plan. Rockets and Satellites are a specialty in their own right even though the data derived from their use fits into several of the other branches.

The fifteen disciplines are: I World Days; II Meteorology; III Geomagnetism; IV Aurora and Airglow; V Ionosphere Physics; VI Solar Activity; VII Cosmic Rays; VIII Latitudes and Longitudes; IX Glaciology; X Oceanography; XI Rockets and Satellites; XII Seismology; XIII Gravity; XIV Nuclear Radiation; XV Meteor Studies.

In the following paragraphs a short explanation of the problems in each is presented. The I.G.Y. objective is discussed, and Canada's part. Space restrictions make it necessary to pick only a few highlights in each case and the discussion is very superficial.

I. WORLD DAYS

"World Days" can hardly be called a discipline but the title is listed as such since an international committee was formed to select them, similar to the committees in the other specialized fields. The purpose was to select days or periods during which measurements would be more concentrated or special measurements taken. The cost of sending up larger than normal meteorological balloons, firing rockets or arranging special observing parties for aurora or meteors, was sufficient to try and arrange a concentration of effort during particular periods.

World Days that could be selected in advance include about four days each month arbitrarily chosen in relation to phases of the moon, special meteorological intervals of ten days every three months, days of solar or lunar eclipses and periods of meteor showers. A special calendar showing these days was prepared and distributed to all national committees.

There is a second type of World Days which cannot be planned long in advance. It was mentioned earlier that a large part of the I.G.Y. objective relates to solar terrestrial relationships and in later sections the possibility of predicting effects on the upper atmosphere due to solar activity are included in discussions of relevant disciplines. By a careful watch on the sun around the world and the use of up-to-date aurora, geomagnetic, and ionosphere data, periods can be predicted when there is likelihood that intense solar flares will occur facing the earth and large disturbances will result.

A World Warning Agency has therefore been established at Fort Belvoir, Virginia, near Washington. Communication channels have been set up between this and key stations all over the world. Up to date data in a coded form are sent in and warnings are sent out to every national group who wants to receive them. If conditions look right for solar activity an alert is called. This merely means that a special world interval may be arranged on short notice. Special world intervals are periods of 24 hours or multiples of 24 hours which are equivalent to world days. One channel of communication is over the United States Time Signal Station (W.W.V.). Anyone who listens to this may have noted that at about 4½ minutes after each half hour a morse signal is transmitted giving the letters A.G.I. "Année Geophysique Internationale" followed by a single letter repeated five times. "A" indicates a state of alert, "E" indicates normal conditions — no alert, "S" indicates that a special world interval will start at 0001 hours GMT the following day. Three long dashes indicates a special world interval is in progress. "T" indicates that a special world interval terminates at 2359 GMT of that day. The predictions also go out over the meteorological communication networks on most continents.

In Canada since we are near the World Warning Agency we use long distance telephone communications between Ottawa and Fort Belvoir. Two telephone calls per day are made during which ionisphere data from all our stations and solar data from Ottawa are sent to Fort Belvoir. The current summary of information about solar activity is returned. The ionospheric data from the northern stations which we send to the World Warning Centre are transmitted to Ottawa by Department of Transport communication channels.

Most of the Canadian I.G.Y. activities are on a continuous basis, therefore, World Days or Alerts have little effect on our projects though they are very important for a program like the rocket project at Churchill. This project has direct service communication channels. Therefore, communications to our remote stations about alerts and special world intervals involved no particular problem for us.

II. METEOROLOGY

Meteorology perhaps more than any other discipline is the one having a practical application that makes geophysical measurements over the whole world necessary. Meterologists admit that a practical forecaster should have some experience in the district in which he is working and to that extent his craft is an art but he bases his analyses on sound scientific measurements at all levels in the atmosphere that affect the weather. He must also be thoroughly familiar with the theoretical, hydrodynamic, and thermodynamic principles that govern the movement and modification of air masses as well as the use of practical measurements to make the calculations necessary for his prediction. There is always a compromise between the cost of a dense net of meteorology stations and getting enough data for forecasting and climatological studies.

One of the important problems in the I.G.Y. is the world-wide circulation of the atmosphere; the difference in radiation from the sun received at the equator and poles results in a circulation of the atmosphere which is broken up into motions resembling vortex rings surrounding the earth more or less parallel to latitude circles. The rotation of the earth introduces Coriolis forces which complicate the pattern through the production of meridional circulations; the inclination of the earth's axis to the ecliptic and the effects of topography and of oceans add to the complication. The cellular structure of the general circulation results in the well known wind zones—the tropical easterlies or trade winds, the middle latitude westerlies, and the polar easterlies. In middle latitudes, the circulation at any instant is dominated by migratory cyclones and anticyclones. The succession of cyclones, with their associated frontal systems, and of anticyclones result in the weather changes that are so familiar to people living at our latitudes.

A more detailed study of the world-wide circulation was obviously an objective to be undertaken at the time of the International Geophysical Year when international co-operation could make possible a considerable expansion of the normal meteorological program.

To make this world-wide study three lines were chosen from pole to pole about equally spaced around the earth but adjusted to convenient land masses. On these lines as many as possible meteorological stations have been established, taking advantage of those already in existence and filling in gaps where necessary. One of these lines is at longitude about 80° West and, therefore, passes through the Canadian Arctic, Southern Canada, the United States, Central America, the west coast of South America, the Falkland Islands, and Antarctica.

The objective is to make twice daily or if possible four times daily rawinsonde balloon ascents up to 30 kilometres and get a complete profile of that part of the atmosphere from pole to pole. This, of course, is being done without any decrease in activity of normal aerological stations; in fact, it has been recommended that 30 km. be the height objective of all aerological stations during the I.G.Y. There are 33 such stations operating in Canada.

The second heavily emphasized I.G.Y. objective is a study of the energy budget of the earth and atmosphere; that is, the heat exchange between the surface of the earth, the atmosphere, and outer space. To give some information which will emphasize the importance of the atmosphere in this regard, with clear skies only about 70% of the sun's radiation reaches the earth, 30% being absorbed in the atmosphere or scattered back to outer space. With overcast skies only about 40% of the sun's radiation gets through to the surface, the rest is scattered back to space or absorbed by the atmosphere. The mean cloudiness over the whole earth is estimated to be 52% and as a result the atmosphere on the average absorbs apphoximately 12% and scatters back to space about 35% of all the radiation we get from the sun. It is interesting to note also that water vapour, though it represents only about 0.2% of the atmospheric gases present, absorbs five or six times as much solar radiant energy as all the other gases combined.

A study of the heat balance involves the continuous measurement of radiation from the sun and atmosphere downwards and radiation from the earth upwards. It involves also some knowledge of the so-called "micro-meteorology" at the surface; that is, the vertical heat exchange by turbulence and conduction in the air close to the surface.

A station to study this heat exchange requires considerable equipment. Since knowledge is lacking more in the Arctic than in temperate zones, in Canada we are concentrating such measurements at two stations, Resolute in the Queen Elizabeth Islands and Moosonee in Northern Ontario, though continuous radiation measurements are being taken at 17 other stations across Canada.

At Resolute there is a 100-foot tower for measurement of profiles of temperature, humidity and wind. Fig. 3 is a photograph of this tower. In addition, there are radiation-recording instruments covering the spectrum from infrared to ultraviolet.

Another important objective is the measurement of ozone in the atmosphere. Ozone is formed from dissociated oxygen and oxygen molecules in the atmosphere at levels from 20 to 60 kilometres. Although it represents only a small fraction of the gas at these levels, ozone is responsible for the abrupt short-wavelength cutoff of solar radiation received at the ground, since it is very opaque to ultraviolet light of wavelengths below about 3,000 angstrom units. Absorption of ultraviolet radiation by ozone and by molecular oxygen is the reason for the temperature maximum in the atmosphere in the vicinity of 50 km., with temperatures of the same order as those observed at the ground.

The integrated ozone amount can be determined by comparative spectroscope measurements using sunlight or moonlight. Ozone in the surface layers is most readily determined by a chemical technique. Both these measurements are being undertaken at Resolute, with total ozone being observed also at three other stations. The surface measurements combined with upper atmosphere measurements give some information on vertical distribution of ozone and, indirectly, on dynamical processes at very high levels.

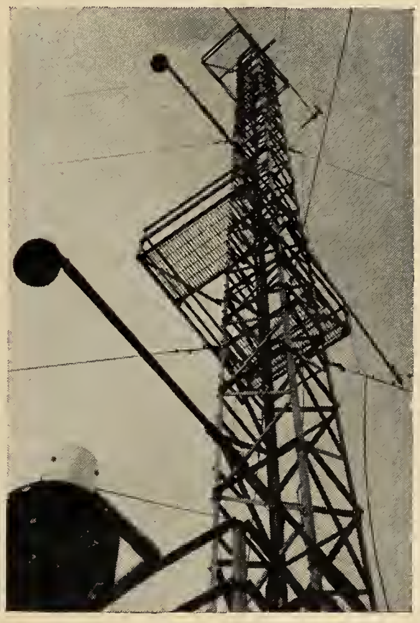


Fig. 3. The meteorological tower, 100-feet high, at Resolute, latitude 74.7°N, longitude 95.0°W. This tower carries instruments to study micrometeorology in the first 100 feet of the atmosphere. (Meteorology Division, Department of Transport).

The distribution of data for the meteorological program is interesting. The World Meteorological Organization (W.M.O.) has been in operation for many years with headquarters in Geneva. They are undertaking the reproduction of routine and special data from every major meteorological station in the world during the eighteen months of the I.G.Y. This will be done on microcards and copies will be available to anyone who is willing to pay the cost of reproduction, about $6,000. These cards are the equivalent of many volumes of printed data.

The meteorological program in Canada is the responsibility of the Meteorological Branch of the Department of Transport, whose headquarters are in Toronto.

III. GEOMAGNETISM

The earth's magnetic field is still of some importance for navigation. It is far from constant in intensity and its variations are of the greatest scientific importance both in studying the interior of the earth, the upper atmosphere, and solar activity. The source of geomagnetism is mostly within the earth. Theories suggest that it is caused by a dynamo action in the molten centre of the earth resulting from its rotation and thermal effects. These create an actual flow of the liquid core and a magnetic field is developed. This internal field changes slowly but at such a rate that secular changes can be observed in a life time.

The perturbations or short term variations are, however, more clearly a part of the I.G.Y. program. The diurnal variation varies in amplitudes in a way that is related to solar activity, and magnetic storms can often be associated with particular outbursts of activity on the surface of the sun. For instance, a solar outburst is very often followed 1 to 4 days later by a magnetic disturbance. The delay represents the time taken for a beam or cloud of particles to reach the earth. This beam or cloud, being ionized, is electrically conducting and on interacting with the earth's field forms a system of electrical currents outside the earth's atmosphere. These can account in some detail for changes in diurnal variation and the form of the commencement of magnetic storms.

The objectives in geomagnetism in the I.G.Y. are to get more information over the whole surface of the earth on the details of the variations found during magnetic storms. Continuous measurements on the earth's magnetic field have been carried out for well over a century and there is a permanent network of stations. During the I.G.Y. this network is being enlarged to include magnetic measurements at remote points not normally occupied, such as the stations in Antarctica. Magnetic measurements are also of considerable importance in studying the aurora and ionospheric disturbances, both of which are related to solar activity. Therefore, a record of changes in the earth's magnetic field is being taken whenever possible at every auroral observing station, that is, every station where a continuous watch with electronic or photographic instruments is kept on the aurora. The onset of a magnetic storm is an indication of a high probability of aurora for several nights following the start of the storm.

In Canada geomagnetic investigations are one of the fields of activity of the Dominion Observatory in the Department of Mines and Technical Surveys. The Observatory normally operates magnetic stations at Resolute, Baker Lake, Agincourt, and Meanook. Starting with the I.G.Y. additional stations have been established at Yellowknife and Victoria, and recording magnetometers have been located at the chain of aurora stations between Resolute at latitude 75°N and Winnipeg. More will be said about this chain of stations in discussing I.G.Y. aurora observations. Magnetic measurements are being taken at eighteen stations in Canada.

Besides direct measurements in the earth's magnetic field, a study of currents in the earth which are probably induced by magnetic changes is very interesting. The study of earth currents is also a very old science but interest in it has been revived recently because it is a convenient way of studying rapid pulsations in the magnetic field, these pulsations having periods from a fraction of a second up to a few minutes.

Modern technology has made it possible to develop an airborne magnetometer which has sufficient precision for geomagnetic surveys and can measure three components independently. Only about four such instruments have been built throughout the world and the Dominion Observatory built one of these. It is being used in connection with the I.G.Y. program.

IV. AURORA AND AIR GLOW

The aurora which makes a brilliant display in the northern sky is caused by streams of particles coming from the sun. Near the earth they are deflected by the earth's magnetic field and make their display in the upper atmosphere, most frequently in a broad ring roughly about 20° of co-latitude away from the geomagnetic poles. The geomagnetic poles represent the axis of an imaginary magnetic dipole at the centre of the earth, the field of which would most closely represent the earth's magnetic field.

The details of the interactions that cause these northern lights are not known but it is clear that an important role is played by streams of protons and electrons. X-rays and ultraviolet light are also known to be present. These particles and radiations collide with air molecules in various stages of dissociation and ionization and in so doing make the brilliant display the spectral analysis of which took many years to unravel. Exchanges between energy levels in atoms and molecules which are normally classed as forbidden and do not occur in laboratory experiments often occur in aurora spectra. This is because of the extremely low pressure and hence long free path of atoms or molecules between collisions which could not be duplicated in any experiment of laboratory dimensions.

One of the important problems in the aurora is the location of the belt of maximum frequency and the frequency of occurrence of various types of auroral patterns. These are being analyzed in relation to solar activity, magnetic and ionosphere disturbances. The height of the aurora varies from about 75 km. up to about 1,000 km., the maximum frequency being just above 100 km. During the 1932-33 International Polar Year height measurements were considered of great importance. A great many such measurements have been made then and in the intervening years, so many that in the current effort the emphasis is more on geographic distribution of the various types and frequency of occurrences.

Several methods of attack are being undertaken. Since the auroral discharges result in or are associated with increases in electron density, radar reflection is a means of studying aurora and this method has been used extensively during the past decade. This has the advantage that the detection of aurora is not limited to darkness or to nights of clear sky.

A photographic technique involves the use of a camera which sees the whole hemisphere of the sky from horizon to horizon (see Fig. 5). This instrument is simply a movie camera mounted on a light frame, usually four thin legs, with the lens pointing downward. It is focussed on a convex mirror and the whole hemisphere of the sky is reflected from the mirror. Photographs taken every minute are studied individually or projected at standard motion picture frequency to study the changing pattern and motions throughout the night. Patrol spectographs are also being used at auroral stations. This is an instrument by means of which the light from a band across the zenith from horizon to horizon is focussed on a slit spectrograph and a photograph of the spectrum is taken every few minutes. Analysis may then be made of the type of excitation and molecule involved in the display.

Another instrument is a photoelectric auroral intensity recorder. This instrument scans the sky in steps from the horizon in the north upwards through the zenith to the horizon in the south. Such a scan is completed in under two minutes. The measured intensity is put automatically on punched tape and the data can be handled by machine methods.

The location of stations to study the aurora has been carefully considered. Though the band of maximum frequency is known to be approximately 20° off the geomagnetic axis it will take a great deal of observation to be certain of the location of this band, how it moves with season and with changes in solar activity. Some groups of auroral physicists have suggested an inner auroral band north of the well known region or alternately a spiral shape for the band rather than a circle.

The location of the auroral band is such that the large portion of it that is not over oceans is in Canada. The geomagnetic pole is in Greenland about 100 miles north of Thule. The band of maximum intensity passes roughly through central Labrador, the south end of Hudson Bay, Churchill, the northern tip of Alberta, central Yukon and northern Alaska, out through the Chukchee Sea, touches the coast of Siberia and northern Norway and Sweden. The only country where a chain of stations crossing the auroral band can be established on land is in Canada. Our responsibilities, therefore, in auroral observations for the I.G.Y. are considerable, and it is not unnatural that auroral research is considered one of the most important parts of the Canadian program.

In addition to instrumental stations which will be described below, visual observers, many of them voluntary, have been organized throughout Canada and northern United States. This is a cooperative effort by the upper Atmosphere Research Group at the National Research Council, organized by P. M. Millman, and an Auroral Research Group at Cornell University led by C. W. Gartlein.

To do this a graphical auroral report form has been designed on a 4 x 6 inch format. This form is quite simple to use and by filling appropriate places on the form the position of the aurora in the sky can be indicated. The shape of the display is drawn in an appropriate place on the card which indicates the quadrant in which it is observed and its angular height. The observer then marks the location of his site, the time to the nearest minute, signs his name and mails it to the aurora centre at the National Research Council, if in Canada, or to a corresponding centre at Cornell University, if in the U.S.A.

The primary aim of this visual program is to secure material for synoptic charts of aurora over North America. Data from the forms are handled by an I.B.M. punched card data analysis system. Both the visual data and instrumental data are being plotted on special maps prepared for the purpose which will be used to present a synoptic picture of the occurrence and type.

Ideally these forms should be filled in every fifteen minutes during auroral displays but all data are valuable and even at places where an observer can only go out and look at the sky occasionally and fill in a card, the data are useful. Valuable cooperation in this project is being given by many types of activity where night crews are necessarily on duty. Radio stations, meteorological stations, aircraft pilots, amateur astronomical groups are examples of people making useful contributions.

In selecting the sites for the instrumental stations, an attempt was made to arrange a fairly dense array of stations at points where there was already a scientific station of some sort and to form a line across the band of maximum auroral activity. A chain of stations was chosen roughly on a line from Alert (the most northerly tip of Canadian territory on Ellesmere Island) to Winnipeg. The stations include Alert, Resolute, Baker Lake, Ennadai Lake, Churchill, Bird, Flin Flon, the Pas, Saskatoon, and Winnipeg. Saskatoon has been a centre for aurora research since the International Polar Year of 1932-33. B. W. Currie, in the University of Saskatchewan, has taken aurora measurements there and jointly with the Defence Research Laboratories at Churchill has built an auroral research centre of considerable international importance.

Besides the concentrated group of stations there are stations scattered in eastern and western Canada. Another less dense line of stations towards the west would include Resolute, Fort Norman, Yellowknife, and Meanook and Victoria. In the east measurements are taken at Knob Lake, Goose Bay, and Ottawa. The equipment scattered among these stations consists of 18 all-sky cameras, 10 photoelectric auroral intensity recorders, 4 auroral radar sets, 5 automatic patrol spectrographs, and height-determining photographic equipment near Churchill. This latter height-determining project is part of the Canadian contribution to the U.S.A. Rocket Project which will be described in more detail in a later section.

The airglow from the night sky is also included in the title of this branch of geophysics. Airglow at high altitudes in the night sky represents the radiations emitted by recombination of ions and molecules which were acted on by sunlight. From spectroscopic studies of the night sky a great deal has been learned about the chemical constitution of high levels in the atmosphere. At Canadian latitudes it is of course difficult to separate airglow from aurora, therefore, not much research has been done in Canada in this field. It is normally studied at more southerly latitudes or at least further away from the aurora band. We have no systematic study of the night sky in our Canadian I.G.Y. program.

Fig. 4 (left) The Dominion Observatory's Research Station at Meanook, Alberta, where a large number of I.G.Y. measurements are being taken. An auroral display is shown, the all-sky camera can be seen on the roof, and a comet is seen to the left of the tower. This picture was taken on 7 August, 1957, by the Dominion Observatory staff.

Fig. 5. The all-sky camera being adjusted by Mr. K. W. Christie of the National Research Council's Upper Atmosphere Research Group. The pictures at the bottom are a row of frames taken with the camera showing aurora.

V. IONOSPHERE

The ionosphere really came to its own during World War II when ionosphere data were used extensively to improve communications. In summary the ionosphere consists of three layers or regions high up in the atmosphere which are kept in such a state of ionization by radiation and particles from the sun that there are enough free electrons and they have sufficiently long free paths to reflect radio waves. The pressures and electron density suitable for reflection of radio waves begins to be effective at heights of about 100 kilometres. There is a maximum in electron density at about 110 km. (at least in daylight) after which the electron density falls off a little, then increases again to a second maximum around 200 km. and a third at 350 and 400 km. These are known as the E, F_1, and F_2 regions respectively. Their heights and electron densities vary with sunlight (the E layer is usually absent at night) with the season of the year, and with the sunspot number representing an index of solar activity. Besides these rather regular variations there are ionosphere storms which are caused by bursts of solar activity.

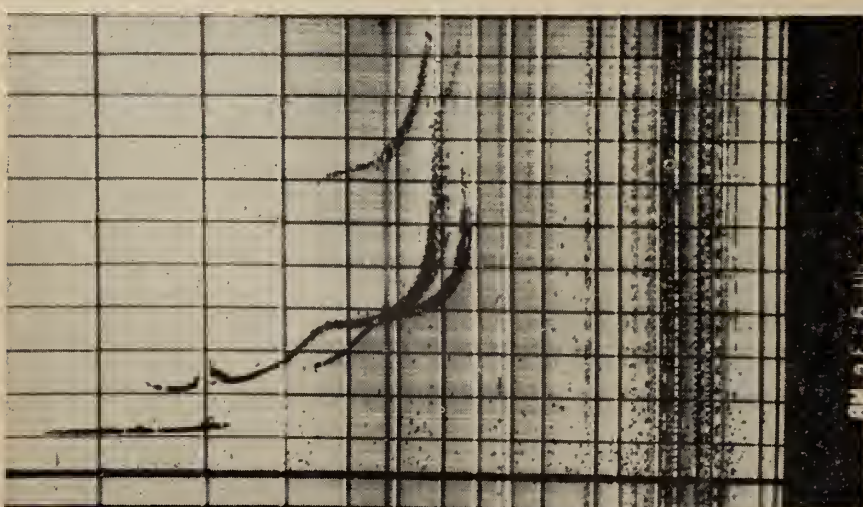
A fourth region lower down, called the D region, forms sometimes at a level of pressures and electron densities which absorbs all of those radio waves which are normally used for communication and causes a complete blackout. This D region occurs at periods of high solar activity and the blackout usually occurs at the same time as magnetic storms and aurora. The ionization which forms the D region is believed to be due mainly to soft X-rays or light waves in the far ultra violet. Radiation from the sun in this region is enormously variable and can only be measured directly by rockets fired to appropriate heights.

The reflecting layers by no means have a smooth and regular pattern. It was mentioned above that besides the diurnal and seasonal variations they are subject to storms. In fact like the weather, though average conditions may be well defined, average weather is rarely experienced. Mean heights and electron densities and their diurnal and seasonal variations are published and these are important in planning radio communication but the variation from the mean is considerable.

The surface of the reflecting layers, like clouds, is broken up into patches and is subject to winds. The main objective in the I.G.Y. is to study the fluctuations rather than the regular behaviour. There has been a network of stations throughout the world studying the average conditions and their variations for fifteen years or so. The I.G.Y. program is adding something to these, covering regions where data are lacking, for instance, Antarctica, and installing special equipment at other stations to study particular phases of the storminess or irregularities in the ionosphere.

The Canadian program has its headquarters in the Radio Physics Laboratory of the Defence Research Board at Shirley Bay, near Ottawa, with a second ionsphere headquarters in the University of Saskatchewan at Saskatoon. Stations are operated at various points in the Arctic and across Canada many of them manned and maintained by the Department of Transport's Telecommunication Division.

Fig. 6. Vertical sounding ionosphere record. This is an actual photograph of the oscilloscope pattern. The vertical lines represent frequencies from 1 to 20 Mc./sec. The horizontal lines are virtual height in hundreds of kilometers. Reflections from the E region and F_1 and F_2 regions are shown with a multiple reflection from one of the latter. (Defence Research Board's Radio Physics Laboratory).



1. Absorption Measurements

The critical frequency at which reflection of a pulse at vertical incidence stops and the beam penetrates the layer gives a measure of the electron density. The time delay of the return echo gives the virtual height. These are the normal measurements recorded at ionosphere stations. A study of the intensity of the reflected signal related to the intensity of the pulse sent out gives a measure of the amount of absorption in the intervening space between the ground and the reflecting layer. This is one of the I.G.Y. projects and is being carried out at five stations in Canada.

2. Audio-frequency Waves (Whistlers)

This is a very interesting natural phenomenon which has led to a greatly increased knowledge of the environment outside the earth's atmosphere. When a lightning flash makes an electromagnetic wave the low frequency components (that is in the audio range from a few cycles per second up to a few kilocycles) are transmitted upwards through the ionosphere. In a conducting media even at very low densities where there is a magnetic field the action of the electromagnetic wave as scattered by conducting electrons makes the wave travel effectively along the lines of force of the magnetic field. Such a lightning flash say at our latitude sends out a burst of energy which follows a magnetic line and returns to the earth at a corresponding geomagnetic latitude in the southern hemisphere. In travelling over this path dispersion of the different frequencies takes place and what is heard is a whistle starting at a high pitch and going through the audio range in a second or two. The wave may be reflected back again and in fact several reflections are often heard.

The path of such a wave from temperate latitudes such as ours travels out from the earth a distance equivalent to three or four earth's radii. This path can be calculated and the minimum electron density in the path can be estimated. This comes to over 500 electrons per cubic centimetre showing a much higher density of matter than had been expected at such levels. Canadian and U.S.A.

groups are working jointly on Whistlers at six stations in Canada.

3. Scintillation and Cosmic Noise Absorption

In trying to measure absorption in the ionosphere at frequencies which can penetrate it, we take advantage of sources of radio waves from the sky. Particular radio stars are used in which the scattering causes the radio source to scintillate like the visible light from a star. Cosmic noise from the sky can also be used to measure the total absorption in the lower ionosphere, the measurements being taken on a simple antenna looking vertically. These measurements are being taken at three stations in Canada.

4. Vertical Incidence and Tides

Vertical incident ionosondes were mentioned early in this section. Five regular stations and nine special I.G.Y. stations take measurements regularly in Canada, the farthest north being Alert. Another type of study is ionospheric tides or changes in E layer levels caused by lunar variations. Continuous measurements on a fixed frequency of the E layer height is used to study this.

5. Forward Scatter

Irregularities in the ionosphere will act as scattering centres of waves of a frequency which normally penetrates the ionosphere. In Canada, near the auroral zone, many irregularities occur in the lower ionosphere which are capable of scattering these very high frequency radio waves, even when very little power is used. A study of these irregularities, some of which are associated with visible aurora is being made from a transmitting station at Yellowknife with receivers at Baker Lake, Churchill, Saskatoon, Sulphur Mountain (near Banff), and The Pas.

This type of measurement is complicated by the presence of meteor trails. These cause bursts of ionization at ionosphere levels which will reflect much higher frequencies than will the ionosphere.

Fig. 6 is a photograph of an actual ionosphere record showing the way the frequency vs. virtual height is displayed by a cathode ray oscilloscope. The vertical lines represent frequency, the range covered being from 1 to 20 megacycles per second. The horizontal lines are vertical height in hundreds of kilometres.

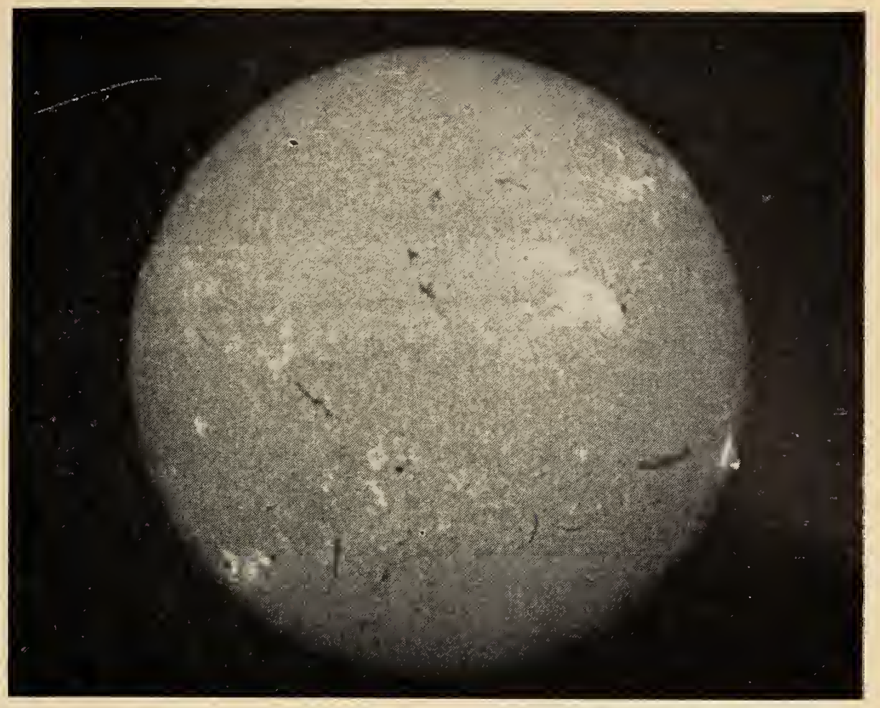


Fig. 7. The sun taken through a filter which passes only the hydrogen red spectral line. A solar flare is seen at the limb (lower right). (Dominion Observatories' photograph).

VI. SOLAR ACTIVITY

As mentioned in the introduction, so many of the branches of physics of the upper atmosphere display phenomena closely related to conditions on the sun that observations of the sun must be a part of the I.G.Y. program. A very simplified description of the behaviour of the sun which produces terrestrial phenomena is the following: Dark spots appear on the surface of the sun in irregular intervals but their average number follows a well known eleven year cycle. (*The present I.G.Y. period was chosen because it coincided with the peak of one of these cycles.*) When the sun is viewed through special filters, bright patches are seen to occur in the region of the sunspots. These events are known as solar flares. While a sunspot or group of sunspots may last several months, individual flares last usually a few minutes, rarely over an hour. A typical series of events is as follows. A strong solar flare will appear near the region of activity containing one or several sunspots. If this is an intense flare, a radio blackout will take place simultaneously on the sunny side of the earth. A small disturbance may be noted on the magnetic record. About 24 hours later (not exactly 24 hours but some time within one or two days), a magnetic storm will start. Ionosphere disturbances will take place, aurora will be seen, and a decrease in the intensity of cosmic rays may be noted.

Like all averages, actual events are never exactly like the typical or average one, and some of the above phenomena may not be seen every time there is a large flare. The simplest explanation of the so-called average sequence of events is that at the time of the flare there is an intense burst of radiation, particularly in the far ultraviolet, which reaches the earth with the speed of light and causes the immediate effects such as a radio blackout on the sunny side of the earth. At the same time a beam or clouds of particles are shot out from the sun with a wide range of energies, but with a velocity much below that of light, reaching the earth hours later and producing the aurora, ionosphere disturbances, and magnetic storms.

Since the correlation with what is observed on the sun and what is measured on the earth is far from perfect, a detailed watch on the sun is an important part of the I.G.Y. program. As the sun rotates, disturbed areas on its surface may be seen as they come over the limb of the sun. A disturbed region if at all large usually lasts for several periods of solar rotation which is approximately 27 days. By watching for these and keeping a close watch for solar flares a prediction can be made for ionospheric and magnetic disturbances. It is much like weather forecasting in that knowledge of all phases of the complicated phenomena is far too incomplete for certainty in forecasting. However, in large experiments like firing a rocket into an auroral display it takes only a few days to get ready and once ready, firing must take place within a few hours; hence any forecast is of considerable value.

A continuous watch can be kept only by having observatories scattered around the earth with suitable equipment for recording what is going on on the sun's surface. A solar flare cannot be seen in the ordinary light from the sun but stands out very clearly if photographed in the light of certain spectral lines, for instance, the hydrogen red line. As many observatories as possible having suitable equipment are taking photographs of the sun minute by minute in this way. Even though practically all large observatories are co-operating, the coverage is not perfectly complete. A whole continental area may be clouded over, making observations impossible.

Another index of solar activity is the intensity of radio waves received from the sun. The intensity of radio waves in the microwave and VHF region varies considerably with conditions in the solar atmosphere. This field of radio astronomy is comparatively young, having grown with the rapid advances in radio technology since World War II.

In Canada our Dominion Observatory at Ottawa is taking pictures of the sun twice a minute at all times the sun can be seen. These are developed every day and data are sent to the World Warning Agency at Fort Belvoir near Washington. Fig. 7 is a photograph showing a solar flare taken by the solar physics group of the Dominion Observatory.

Three groups are also taking measurements on solar radio emissions. The National Research Council has extensive equipment working at a wavelength of 10.7 centimetres. A large fan type antenna has a resolution of only 2 minutes of arc, so that the location of the emission on the sun's surface can be observed at least to the extent of looking at a slit across its disc. The Defence Research Board at Shirley Bay, near Ottawa, are taking measurements at 50 and 500 megacycles, and the University of Toronto is using 300-megacycle equipment at the David Dunlap Observatory at Richmond Hill.

Much could be written on the problem of organizing the collection of data at the World Warning Agency at Fort Belvoir and distributing it to remote stations who want to use it. The data comes from many countries and a great variety of communication channels are used.

VII. COSMIC RAYS

The study of cosmic rays is important in geophysics because they represent another phenomenon that is strongly influenced by solar terrestrial relations. Cosmic rays are the nuclei of atoms of the known elements, the relative number of particles of different masses being about the same as the numbers of different elements throughout the universe. Primary cosmic ray particles are about 85% protons, all but 1% of the remainder are helium nuclei or α-particles, and the 1% represents the heavier elements presumably through the mass spectrum. Their energy is very high, much higher than the energy of individual particles found in nuclear physics. The highest energy available in any one particle from nuclear interactions is of the order of 20 x 10^6 electron volts. Cosmic rays would hardly be classed as such unless they were in the hundreds of millions of electron volts and the highest energies observed in individual events are of the order of 10^{18} electron volts.

These energetic particles come from interstellar space. The exact process by which they acquire their energy is not definitely known but theory suggests that charged particles having moderate energies and interacting with moving clouds of matter containing magnetic fields can gain energy up to the amounts observed.

Since the cosmic rays are charged particles their motion is affected by the earth's magnetic field. The theory of this has been well worked out and measurements agree to the extent that the flux of particles reaching the equator is considerably less than that reaching polar regions. When the distribution in intensity over the surface of the earth is examined in detail, discrepancies are found which we hope will be cleared up by some of the I.G.Y. measurements from satellites.

The discrepancies lie in the fact that the theory is based on the assumption that the earth's magnetic field can be represented by a magnetic dipole near the centre of the earth. Surface anomalies make the location of the magnetic poles some distance away from the axis of the dipole but it would be expected that the surface anomalies would not be effective at any great distance from the earth and the cosmic rays would react as though affected by the nearest equivalent dipole. Recent surveys over equatorial regions show that this is not the case and the measurements indicate that the more complicated pattern of the earth's field must have considerable influence on cosmic ray particle orbits. In this type of study cosmic rays are being used to obtain information about geomagnetism just as much as the inverse has been true.

Surface measurements are complicated by the fact that the primary particles do not penetrate far into the atmosphere without colliding with an air nucleus. The collision results in an exchange of nuclear energy and in interactions at such high energies all the fundamental particles of nuclear physics may be created. In fact many of them were discovered in studying cosmic rays. Enough is known about the penetration of the secondary particles to sea level to use sea level measure-

Fig. 8. The National Research Council's Cosmic Ray Laboratory on top of Sulphur Mountain near Banff, Alberta. Altitude 7,490 feet. The antenna in the background is for ionosphere scatter experiments from a transmitter at Yellowknife. (Alberta Government photograph).

ments to interpret intensity changes in the primary flux. The energy loss in penetrating the atmosphere, however, limits surface measurements to the interpretation of the behaviour of primaries above a minimum energy of about 10^9 electron volts. The interpretation is also complicated by atmospheric corrections.

There is a great advantage, therefore, in being able to take measurements outside the atmosphere in a satellite, in rockets or near the top of the atmosphere with balloon-borne equipment. The first U.S.A. and the second U.S.S.R. satellite both contained cosmic ray measuring equipment. A considerable part of the effort of the rocket program at Churchill is devoted to cosmic rays.

Fig. 9. The camp at Hazen Lake. This is the Defence Research Board's expedition to Hazen Lake on Northern Ellesmere Island about 500 miles from the North Pole. (G. F. Hattersley-Smith, leader of the expedition).

In spite of the advantage of high altitude measurements, long-term intensity changes can still best be studied with large and heavy apparatus at ground level, preferably on mountain tops. These are very important because of the intensity changes that are connected with solar activity. Five times in the history of cosmic rays sudden increases in intensity have been observed, each one associated with a strong solar flare on the sun. Many such flares have occurred without any observable effect on cosmic rays. Analysis of these indicates that a burst of particles of energies up to perhaps 30 x 10^9 electron volts must be produced in the sun but their motion is modified by some form of clouds of very tenuous interplanetary matter having a large electrical conductivity and magnetic fields bound to the cloud because of the high conductivity.

Other types of variations in intensity are: occasional rapid decreases associated with magnetic storms, a quasi-periodic variation of the same period as the sun's rotation, a slow change in intensity following changes in solar activity but in the opposite sense, and a diurnal variation.

The Canadian program was largely planned with the objective of studying these intensity changes. We have four stations: Ottawa, Resolute, Churchill, and one on top of Sulphur Mountain near Banff. These are operated by the Division of Pure Physics of the National Research Council. A further group of measurements is being undertaken at Deep River by a research group in Atomic Energy of Canada Limited.

In order to study the nuclear interactions we are also sending special nuclear photographic emulsions on balloon flights to heights in the atmosphere as high as 140,000 feet. Nuclear interactions take place between primary cosmic rays of high energy and the elements in the emulsion. This is a well known technique of studying the nature of the primary cosmic rays.

Fig. 8 is a photograph of the laboratory on top of Sulphur Mountain built there for cosmic ray studies.

VIII. LATITUDES AND LONGITUDES

The I.G.Y. objectives in latitudes and longitudes is largely related to the rotation of the earth and its exact shape. The title "Latitudes and Longitudes" refers to the fact that the earth's axis has small precessional motions, and the position of the poles on its surface changes slightly throughout the ages. These changes have been studied for years. Some changes are regular or periodic and can be predicted, others are not. The results of these motions are changes in mean solar time.

Geodetic measurements across a country like Canada are referred to the spheroid accepted as the most exactly known shape of the earth. The actual measurements, of course, are made on the geoid or the surface of uniform gravitational potential. Correcting to the spheroid is done if gravity anomalies are known. A survey of one continent is referred to the spheroid calculated from measurements on that continent and is not necessarily the same spheroid as used in some other continent's net. One of the objectives of the I.G.Y. is to try to get a more accurate knowledge of the exact shape of the whole earth.

The satellite program is very important in that objective. The ellipticity of the earth causes precessions in the satellite's orbit, the measurements of which gives a measure of the shape of the ellipsoid that is independent of surface geodetic measurements. Further, by accurate timing of the satellite from several stations, intercontinental distances can be calculated.

Another technique recently developed is the dual-rate moon-position camera. The dual-rate feature of this camera makes it possible to take a photograph of the moon and stars holding both still on the the photographic plate. Since the position of the moon is known with high accuracy each photograph makes possible a measure of the observer's co-ordinates with respect to the centre of the earth. Similar observations from several stations may produce another measure of the shape of the earth without reference to gravity. Also each photograph aids in the determination of ephemeris time, which in turn defines the unit of time, the second. Canada's program in this field is to operate one of the Markowitz dual-rate moon cameras mounted on the Dominion Observatory's 15-inch equatorial telescope.

The Dominion Observatory, by use of the photographic zenith telescope, is also co-operating with other observatories around the world in studying variations in solar time, in measuring the variation of latitude, and in the distribution and reception of radio time signals.

IX. GLACIOLOGY

About one-third of the important glaciers within the Northern Hemisphere are in Canadian territory. Glaciers have an important bearing on hydrography of land areas and considerable influence on climatology. In the section on meteorology the importance of the energy balance between the sun, the earth, and its atmosphere was emphasized and some complications in its measurements were suggested. The heat balance is very critical in changing the surface of the earth, and geological studies in the past suggest more than one ice age. The amount of the earth covered with ice would be expected to change considerably with comparatively small changes in solar radiation or small changes in the inclination of the earth's axis to the ecliptic.

It is, therefore, rather important that glaciers be studied, particularly, that studies of as many ice fields as possible be made from time to time so that slow movements and growth or recession can be recorded. Melting and growth are important and there is a great storehouse of climatological data in glaciers because by digging into them the annual layers of melting can be seen for many decades of years back just like rings in a tree.

Glaciological studies were rather neglected in Canada until a few years ago but there is an active group now in the University of Toronto, Institute of Geophysics, McGill University's Geography Branch, and research is starting in the University of British Columbia and the University of Alberta. The Defence Research Board has an active interest and is operating a glaciological expedition in Northern Ellesmere Island during the I.G.Y. The National Research Council's Division of Building Research has an active interest in snow, ice, and permafrost problems related to buildings and transport.

The following expeditions were undertaken as part of the I.G.Y. program. During the summer of 1956 an expedition organized by the University of Toronto went to the Salmon Glacier near the British Columbia coast. This was considered a pre-I.G.Y. expedition. It was repeated during 1957. Measurements were taken on the thickness of the ice by seismic methods. Samples were collected down to considerable depth, movements of the glacier and ablation were studied, gravity and magnetic surveys were made and, of course, meteorological observations.

The Defence Research Board is now operating an expedition to the glaciers near Hazen Lake in the northern part of Ellesmere Island about 500 miles from the North Pole. A party of four spent the winter there in 1957-58 and will be augmented during 1958 to take more scientific measurements during the summer. Geological work will be carried out in this area and studies of erosion as well as the

Fig. 10. An Aerobee rocket being fired at Churchill, Manitoba. The tilted launching tower is shown and some of the radio telemetering equipment. (Official U.S. Army photograph).

measurements mentioned in the previous paragraph.

The National Research Council's Committee on Soil and Snow Mechanics is carrying out a modest survey of snow, largely a study of its mechanical properties in relation to meteorology at seven stations spread across Canada.

A group in the University of Toronto has just completed a map and listing of all Canadian glaciers. This has been prepared from aerial photographs and will be of immense value in planning future studies.

Fig. 9 is a photograph of the camp of the Defence Research Boards' group at Hazen Lake.

X. OCEANOGRAPHY

The physics, chemistry, and biology of our great oceans are very complicated, but of great importance to the world's economy. A casual look at standard books on the oceans shows unanswered research problems in every branch of science. The I.G.Y. objective centres around co-operative studies of the circulation of the great oceans, the exchange of water between layers near the surface and at great depth, and more detailed observations of mean sea level.

A complete survey of the circulation in the great oceans cannot be carried out very often. One of our objectives is to see what changes have taken place in the layering and the physical and chemical properties of the Atlantic Ocean since surveys made by a group of ships twenty-five to thirty years ago. In the Pacific an attempt is being made to get a reasonably complete picture of its circulation. Certain other areas have been chosen where more detailed studies will be carried out. For instance, a detailed survey of the Western North Atlantic is being carried out in the Baffin Bay, Davis Strait, and Labrador sea area. This is being co-ordinated by the International Commission for Northwest Atlantic Fisheries. In the Eastern Pacific several co-operative surveys have been planned under the NORPAC Committee of the International North Pacific Fisheries Commission.

Canada has two oceanographic stations taking part in these measurements, one on each coast. These stations are part of the Fisheries Research Board's station at St. Andrew's, New Brunswick, and Nanaimo on Vancouver Island. Two or three ships operated by the Royal Canadian Navy are usually available on each coast for oceanographic work. Measurements at sea consist of temperature measurements and sampling for salinity and other chemical constituents at various depths in the ocean. Some of the chemical measurements require immediate analysis; therefore, ships for this purpose have to be equipped with laboratories as well as special winches for handling the equipment.

All levels of land are referred to a level known as mean sea level. Mean sea level would represent a surface of constant gravitational potential except for modification by winds and circulation of the oceans. One of the I.G.Y. objectives is to establish recording tide stations in remote areas such as Arctic and Antarctic regions. This is not only to measure tides at such points but to establish mean sea level. Canada normally operates six sea level recording stations, but because of the I.G.Y. established two new stations on difficult locations on Brevoort Island off the Labrador coast and at Resolute in the Arctic. Establishing a tidal station on a shore that is continuously pounded by ice is not very easy. One way is to build a channel below the ice, running it inland then up to the surface where equipment can be installed. Part of this may be through permafrost and has to be kept warm enough to avoid freezing.

Tidal measurements are the responsibility of the Hydrographic Survey of the Department of Mines and Technical Surveys. The Department of Transport operates two weather ships, one in the Atlantic and one in the Pacific Oceans. Oceanographic measurements are also being taken from these ships.

XI. ROCKETS AND SATELLITES

Although the science of firing large rockets and getting satellites on a stable orbit involves many branches of physics and chemistry and the actual launching is an engineering project of considerable magnitude, as far as the I.G.Y. is concerned rockets and satellites are merely vehicles to be used to carry instruments into the upper atmosphere or outside the atmosphere so that direct measurements can be taken some distance away from the earth's surface. This technique, during the past decade, has made it possible to get information that previously could only be deduced indirectly from spectroscopic or radio measurements. The military requirement for weapons of this sort has created the opportunity for great advances in the physics of the interesting space surrounding the earth. Of course, knowledge of the nature of the space in which a long range ballistic missile must travel is a necessary adjunct to the practical use of such missiles, but the international political rivalries that have made the development of these tools possible for scientific measurements will be by no means wasted even if, as we hope, they are never to be used in anger.

The I.G.Y. published program shows that several countries are undertaking rocket projects. These are U.S.A., U.S.S.R., U.K., France, Australia, and Japan. Only two countries are attempting to launch satellites, U.S.A. and U.S.S.R., and at the time of writing both have succeeded. Although Canada has no rocket or satellite of its own we are acting as hosts to a very large United States rocket project at Churchill. We are contributing a share of the ground work in meteorology, height recordings of the aurora, and ionosphere measurements. In the satellite field we are unable to see the United States satellite because its orbit does not reach far enough north but measurements were taken on both the U.S.S.R. satellites that were fired up to the time of writing this paper. Radio measurements were taken by the Defence Research Board's laboratories at Shirley Bay near Ottawa. By a study of the Doppler shift in frequency during two successful passages of the satellite and further measurements 24 hours later a very precise calculation of the orbit was made. The Dominion Observatory staff undertook visual and photographic observations and collaborated in the orbits calculations.

Fig. 11. The track of an Aerobee-Hi rocket as it was fired at Churchill, Manitoba. Firing of July 5, 1957. (Official U.S. Army photograph).

A study of the atmospheric structure is a simple way of expressing the objective of a large number of ingenious rocket-borne experiments. Several different methods of measuring temperature, pressure, and density variation with height right up to the limits of the range of the rockets are being used. The general structure of the atmosphere is represented by a decrease in pressure from the surface up to some undefined level which might be considered a transition from the atmosphere to interplanetary space. Since it is becoming accepted that the solar atmosphere extends out to the orbit of the earth we never reach the low density of interstellar space but at any altitude within the range of rockets or present satellites there is still a residual density of gas probably hundreds of times greater in density than instellar space but still many thousand times less dense than the most perfect vacuum obtainable in the laboratory.

The temperature of the atmosphere decreases with height up to the tropopause then after a short isothermal layer increases to a temperature about equal to that at the surface of the earth at a height of about 50 km. It then decreases again to a minimum at a height of 80 km. and from there up into the sun's atmosphere increases again probably to thousands of degrees. The layer showing the lower increase is that at which ultra-violet sunlight is absorbed by ozone and oxygen. The magnitude of the increases and decreases even above about 40 km. varies with latitude and season. When one gets into the electrically conducting layers from 100 km. up there is evidence of considerable turbulence and large variations related to solar activity. These are the regions of the aurora and ionosphere storms which have already been mentioned. The conductivity remains high and at heights perhaps of the order of the earth's radius some theories suggest turbulent motion controlled by a combination of electromagnetic and gravitational forces.

The instruments used in the rockets and satellites are much too varied to be presented in any detail here. A few of those used in American rockets at Churchill might be mentioned. A simple way to study the density of the atmosphere is by firing explosive grenades from the rocket at intervals as it ascends. From radio and photographic observations the position of the rocket at any instant is known, and by sound ranging on the explosive charges the temperature can be measured. Density can also be measured by a light falling sphere containing a very accurate accelerometer which telemeters the data to the ground station. Magnetometers are carried to record the earth's magnetic field and a mass spectrograph measures its chemical composition and state of dissociation. Radiation from the infrared to the ultra-violet and X-ray region is measured by photoelectric methods, geiger counters, and scintillators. Cosmic rays are measured by counter or ionization chamber techniques.

In the case of satellites, the instrumentation problems involve the best known techniques of miniaturizing and operating with a minimum of battery power. One problem in satellites is the storage of data and making it available on interrogation. In many objectives, for instance, the measurement of cosmic rays, it is important to have continuous measurements yet it would be quite impossible to organize a great enough density of radio listening stations to keep constant contact with it. The data are therefore put on recording systems or memory circuits and played back on interrogation so that all the data collected in one or several passages around the earth can be played back in a few seconds. The University of Iowa, Cosmic Ray Group, have developed a very ingenious magnetic tape recorder which carries enough tape for 120 minutes of operation that is enough to complete one orbit. Actually the tape is moved in steps every second and data put on in that interval. On interrogation by a radio frequency signal the tape record is played back in a few seconds. At the same time the signal on it is wiped off and the tape is ready for another record.

Instrumentation for tracking both rockets and satellites is large and complicated. Tracking equipment for the rocket program at Churchill includes automatic tracking radar sets feeding a rapid electronic computer which produces an instantaneous plot of the rocket's position as it travels. The accuracy of such tracking is considered to be ±500 feet. For more accurate positioning a system known as DOVAP (Dopper Velocity and Positioning System) is also used. The velocity of the rocket can be obtained very accurately and, combing this with radar and cine-theodolite photography, the position of the rocket can be obtained to within a few feet.

Precision in the tracking of satellites is also very important. The ellipsoidal shape of the earth and large gravity anomalies introduce perturbations into the satellite orbit, and precise measurements will give information on the earth's shape which is very difficult to get from geodetic surveys. In planning their satellite the United States group chose 108 megacycles per second for their signal frequency to be transmitted from the satellite, since that frequency would be high enough so that ionosphere diffraction effects would be very small. The U.S.S.R. chose 20 and 40 Mc/sec. but did not announce these frequencies far enough in advance of their firing to give other countries much time to prepare for precision measurements. It has been found that quite accurate positioning can be done on the U.S.S.R. satellite and the two frequencies, being considerably affected by the ionosphere, give information about the ionosphere as well. It might be mentioned here that the electron density above the F_2 layer cannot be measured from below since frequencies below the critical for the maximum electron density are all reflected, and above the critical frequency penetrate the layer and are lost. It is very desirable, therefore, to be able to transmit downwards from above the F_2 layer to study radio wave transmission at higher levels. Rocket and satellite experiments both include such measurements in their plans.

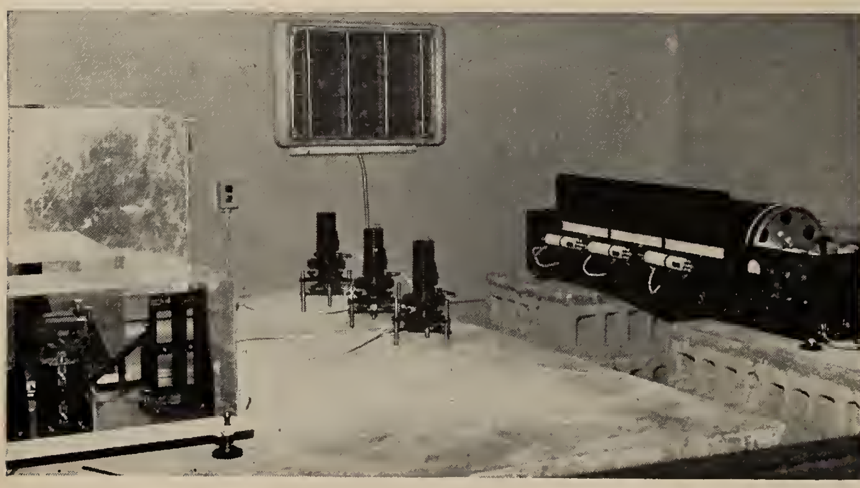
Before leaving this branch of I.G.Y. activities a word about the launching of rockets should be included. Three types of rockets are commonly used for scientific measurements by the U.S.A. groups. Two of these types are being used at Churchill during I.G.Y. activities. The largest of these is the Aerobee or Aerobee-Hi. This is a rocket propelled by liquid fuel consisting of red fuming nitric acid as an oxidizer and a mixture of aniline and furfuryl alcohol as the fuel. The rocket is 15 inches in diameter and normally 23½ feet long. However, an extension may be put on the rocket head between the body and nose cone to carry a variety of instruments. A booster is usually added to the rocket to assist at take off but this only burns for 2½ seconds. The height reached, of course, depends on the payload but a typical performance at Churchill is the carrying of a payload of about 150 lb. to a height of approximately 150 miles.

The second and smaller rocket is called the Nike-Cajun which is a Cajun rocket with a Nike booster. Solid fuel is used in this rocket and its launching procedure is very much simpler. It carries a payload of about 50 lb. to a height of 100 miles.

The exact number of these two rockets to be fired at Churchill is not known as plans change from time to time but the total may well be near 100 and this will represent a large fraction of the total U.S.A.-I.G.Y. rocket program. Two of the Nike-Cajun rockets have been allotted to Canadian use and will be instrumented by the Canadian Armament Research and Development Establishment at Valcartier. The measurements will be in the infra-red spectrum of the radiation encountered at high altitude.

A third type of rocket used extensively in I.G.Y. measurements is the Rockoon or a balloon and rocket combination. Large plastic balloons filled with helium can carry payloads of 230 lb. to an altitude of about

Fig. 12. The interior of the seismological vault at Resolute, latitude 74.7°N, longitude 94.9°W, on Cornwallis Island. This vault is built underground in rock permanently below freezing temperatures. (The Dominion Observatory).



80,000 feet. This takes it through all but about 5% of the atmosphere. A relatively small rocket carried by such a balloon and fired at 80,000 feet can carry a useful payload of about 8 lb. up to 75 miles. Rockoons will not be released at Churchill and are usually fired at sea because it is impossible to predict where they will come down.

The firing site at Churchill involved considerable engineering construction. The tower which guides the take-off of the Aerobee-Hi is 112 feet high and may be set at an angle up to 10° from vertical in any direction. Associated with this, fuel handling buildings, rocket preparation buildings, a laboratory for assembling and testing the instrumentation, and a complete power plant had to be constructed. There are in all eight buildings connected by tunnels and a number of auxiliary huts and trailers at recording sites. Special problems were involved in that the launching tower for the Aerobee-Hi had to be enclosed so that it could be heated during the loading and preparation of the rocket, then the walls opened up to vent the gases when it was fired. Figs. 10 and 11 are photographs of the Aerobee launching tower. In both pictures a rocket has just been fired and is still visible in Fig. 10.

Fig. 13. The meteor observatory at Springhill near Ottawa, showing the observatory building, the antennae for auroral radar and the visual meteor observing station in the background. The observatory represents one of the activities of the Upper Atmosphere Research Group, Radio and Electrical Engineering Division, National Research Council. (See article on page 68).

XII. SEISMOLOGY AND XIII. GRAVITY

These disciplines are presented together because they both refer to studies of the interior of the earth and both are necessarily organized on an international scale quite apart from the I.G.Y. The inclusion of seismology and gravity measurements in the I.G.Y. was largely to take advantage of expeditions to remote parts of the earth such as Antarctica and even at sea when ships on voyages for scientific purposes may be used.

Canada normally operates twelve seismological stations. These belong to the Dominion Observatory and the data from these are fed into the international pool for earthquake studies throughout the world.

The station at Resolute is considered the most important in Canada and perhaps one of the most important in the world. This is because the majority of the seismological stations are located where there is a reasonable density of population, thereby neglecting polar areas. We have land nearer the north pole than other countries (except Greenland) and to take advantage of this the Dominion Observatory is enlarging its seismological station at Resolute. A new vault was built last year and it is now equipped with a variety of the best designs of seismographs. Fig. 12 is a photograph taken inside the underground vault.

Measurements on gravity are important in geodetic work and in geophysical exploration, and a network of gravity stations is gradually being extended over the whole of Canada. One of the most important problems at present is to obtain series of measurements over as much of the world as possible using the instruments that can be related to the same absolute standard of calibration. Another problem is the measurement of gravity on an unstable foundation such as at sea, on floating ice or over soft soil areas. The Dominion Observatory is undertaking research in this field.

The interesting phenomenon of earth tides, which has received increasing attention during the last decade is included in the I.G.Y. program. The surface of the earth expands and contracts under the influence of solar and lunar gravity just as the oceans do. This may be recorded on the most sensitive gravity meters. Measurements on earth tides are being undertaken by the Dominion Observatory at a number of stations throughout Canada.

XIV. NUCLEAR RADIATION

The study of radioactive matter in the atmosphere and in the oceans was accepted as an international program very late in the planning of the I.G.Y. It was first considered in 1956 with the result that the program is more limited than might be. Since Canada is taking part in the program the objectives should be included in this survey.

The overall objectives are twofold, to carry out a world-wide survey of natural radioactivity in the atmosphere before it becomes completely swamped by further nuclear explosions, and secondly to make a world-wide survey of the artificial radioactivity that is in the atmosphere at this epoch. A complete and detailed survey throughout the atmosphere would be beyond present facilities and the quantity is not believed to be very serious at present. It is known, however, that a great deal of the radioactive matter shot into the upper atmosphere from an atomic explosion remains there for months and slowly filters out. Sometimes appreciable quantities are brought down by precipitation, particularly heavy wet snow.

The natural radioactivity in the atmosphere consists of the products of the radioactive minerals near the surface of the earth. The gaseous products diffuse into the atmosphere and can readily be measured. The active decay product most easily measured is radium C and, to measure it, immediate counts have to be taken after exposure of a filter.

The simple procedure we have adopted is to draw outside air through a special filter at a known rate and for a definite period. An immediate measure of the activity after stopping the filter gives information about the radium decay products. After about three days the natural radioactive matter has decayed away to a very low background and the atomic explosion debris may be measured.

A great deal of work is being done along these lines by the United Nations Health Organization with the objective of keeping a watch on health hazards. The I.G.Y. program on the other hand is intended as a study of the physical processes involved in the maintenance of the material in the atmosphere, how it gradually falls out, and a world-wide survey of the present situation.

The international program also recommends the carrying of filters in aircraft to high altitudes, and measurements at sea. Samples of water from deep in the sea are also part of the I.G.Y. program. From these samples, interesting studies can be made of sea circulation, particularly showing evidence of stagnant water at great depth by measuring its tritium content.

The Canadian program is limited to taking filter samples at fourteen stations distributed as uniformly as possible in Canadian territory. Arctic stations as far north as Resolute are included, and stations from Victoria to Halifax. All these are sending in daily filter samples and immediate measurements of natural radioactivity are being taken at some of them. The nuclear radiation program is being organized by the X-Rays and Nuclear Radiations group of the National Research Council's Division of Applied Physics.

XV. METEOR STUDIES

Meteor studies are not listed as a separate discipline in the International program but because an organized program has been carried out in Canada for some years we have listed the Canadian contribution separately. In most other countries meteor studies in relation to the I.G.Y. are included in ionosphere or aurora measurements.

Meteor studies contribute a great deal to the physics of the upper atmosphere. They are important astronomically because they are believed to represent a part of the solar system that is not completely known. They are small particles of matter travelling either individually or in clouds at suitable velocities to stay in an orbit about the sun, sometimes an elliptical orbit of high eccentricity. When they strike our atmosphere their surfaces are heated and vaporized through collision with the atmospheric molecules. They ionize the gas in the atmosphere particularly at levels between 80 and 120 kilometres. They also leave a trail of ionized particles of their own material. This trail is visible at night as a shooting star and the density of ionization is great enough and lasts long enough (sometimes for seconds or minutes) to reflect a radar wave.

Studies of meteors give valuable information about turbulence and variations in the density of the atmosphere at the levels at which they burn out. They are very important in cosmological studies of the growth of planets and raise problems about the amount of matter that the earth may be collecting from the meteors which strike it.

The meteor work in Canada is carried out jointly by the National Research Council's Upper Atmosphere Research Group and the Dominion Observatory. One of the objectives is to correlate visual observation with radar observation. Visual observation can only be carried out at night but radar observation is continuous.

There are a number of well-known meteor swarms whose orbits cross that of the earth at times that can be predicted. These times are listed in the calendar of special world intervals which was mentioned in an earlier section of this paper. Accurate density measurements, that is, numbers in the swarm, are part of the program.

The National Research Council has a special meteor observatory at Springhill about twenty miles south of Ottawa (see Fig. 13). Radar measurements are continuous here and visual measurements are organized on selected nights. Additional radar measurements are taken on world days. The aurora radars at Resolute, Baker Lake, Ottawa and Saskatoon will also observe meteors. Ionosphere scatter experiments mentioned in the section on the ionosphere also show reflections from meteor trails. In fact the Defence Research Board's Radio Physics Laboratory has recently perfected a communication system wherein messages may be transmitted by reflection from a meteor trail. The system waits until a suitable reflection occurs, then transmits automatically at high-speed. The number of meteors is quite sufficient to provide a useful communication channel and frequencies may be used that are not subject to ionosphere disturbances.

The Dominion Observatory's station at Meanook, Alberta, has special photographic equipment for meteor studies. Two Super-Schmidt cameras located 26 miles apart are used to measure heights and velocities by triangulation. These cameras are of special design having a very large aperture ratio and wide angle coverage but of short focal length.

A voluntary visual program extending across the continent has also been organized jointly by the Dominion Observatory and the National Research Council.

CONCLUSION

It is hoped that this brief review of the objectives and program of the International Geophysical Year gives some picture of what is being attempted throughout the world. It will be some years before the total results can be published and in fact some parts of the data will be retained mainly to represent conditions in this epoch to be compared with a future effort at some later date.

From beginning to end the effort is one of co-operation not only on an international scale but even in countries undertaking a large program. It has reached a stage now that the year is more than half over that there is assurance that most of the planned program is being carried out successfully. Our Canadian program is proceeding except for minor details exactly as planned in the report "The Canadian Program for the International Geophysical Year" issued in May 1957 by the Associate Committee on Geodesy and Geophysics of the National Research Council.

To emphasize the importance of cooperation, although this paper is under the authorship of one individual, the information in it could only be presented after discussion, correspondence and meetings with the leaders and members of the various groups undertaking the works. The assistance of these scientists, too numerous to list here, is appreciated by the author. The author would also like to express appreciation of those who supplied the photographs. Acknowledgment is made where appropriate in the captions.

The CARDE I.G.Y. Upper Air Research Program

R. F. Chinnick, *Superintendent, Electronics Wing,*

Canadian Armament Research and Development Establishment

Read at the 72nd Annual General and Professional Meeting of the Engineering Institute of Canada, Quebec City, May 1958

A brief review of the objectives of the CARDE high altitude experiment is given, and the design considerations and techniques employed in preparing a nose cone are discussed.
Methods of packaging electronic components and problems resulting from the environment are considered. Instrumentation techniques for transmitting data are described.

THIS PAPER describes a programme undertaken by CARDE to measure characteristics of the night air glow at altitudes from 70 to 100 kilometres employing test rockets fired from Fort Churchill, Manitoba. The CARDE programme is an integral part of the International Geophysical Year and as such it is hoped that information obtained will contribute to the general knowledge of upper atmospheric physics.

Upper air research programmes employing guided missiles such as the V-2 were initiated on this Continent in 1946 and since that time several sounding rockets have been developed for transporting scientific instruments to high altitudes. By far the majority of the early work was carried on at the White Sands proving grounds in New Mexico. From many points of view, however, it is most desirable to extend the explorations of the upper atmosphere to other geographical sections of the earth and in particular to Polar regions where somewhat different conditions may exist especially with respect to auroral activities.

Early in the planning of the I.G.Y. programme, arrangements were made between the Canadian and United States Government to employ the Fort Churchill area for many portions of the rocket programme. Fort Churchill is ideally suited for this purpose since it is in the auroral belt, sufficient land exists for rocket impacts, and technical facilities and logistical support are available.

Initial planning called for the firing of 33 Aero Bee and 43 Nike-Cajun rockets of which two of the Nike-Cajun Rockets were made available to CARDE for the programme which is about to be described. The Nike-Cajun Rockets which are being made available to CARDE are relatively inexpensive test vehicles capable of carrying pay loads in the range of 30 to 100 lb. to altitudes varying from 175 to 100 kilometres depending on the pay load. Further, to reduce the load on the research organization making the measurement, the I.G.Y. Committee have installed at Fort Churchill the necessary instrumentation and communication facilities to ensure the obtaining of trajectory information, and of providing a telemetry link between the rocket and the base station.

Each research agency therefore has the task of designing an instrumented nose cone capable of making the measurements for which it is committed and transforming this information into electrical energy in a form suitable to be injected into the Dovap (Doppler velocity and position system) telemetry system for transmission to the ground.

The following information will help to introduce the measurements being made and present some background data on the problem.

Thermal Emission from the Night Airglow

The night airglow or the " permament aurora " as it used to be called consists of the radiation emitted by the atmosphere during the night. In addition to the thermal emission of the low atmosphere, four emissions are well known. These are the red and green lines of oxygen, the yellow sodium doublet, and the vibration-rotation bands of the hydroxyl molecule. The atomic lines lie in the visible and are readily observable with photo-multipliers. The hydroxyl radiation extends from 4.3 microns to 5000A but the radiations in the visible are rather weak. The greatest intensity is from 2.8 to 4.3 microns where the atmospheric attenuation makes ground level observation impossible.

Nine sequences of hydroxyl vibration-rotation bands are believed to occur. Those in the visible have been observed spectroscopically by Meinel and Dufay. The region from 8000A to 11000A has been investigated by Krasovski[1] using an image tube at the focal plane of an auroral grating spectograph. Vallance Jones[2] and co-workers at the University of Saskatchewan have investigated the spectrum from 1.0 to 2.0 microns with a PbS cell and are currently attempting to extend their observations to 4 microns using a PbTe cell .In addition to these spectroscopic observations, several observers[3] have used filter photometers with various detectors to find the total amount of radiation emitted in various spectral regions.

Height of the Emitting Layer — Using the Van Rhijn technique,[4] Roach, Pettit and Williams obtain an altitude of 70±20 kilometres for the centre of gravity of the OH layer. Meinel measured rotational temperatures and obtained 220°K. which corresponds to about 70 km. also. However, Krasovski has observed rotational temperatures as high as 400°K.

The Van Rhijn technique involves several assumptions which make the value obtained very doubtful. The only good method for altitude determination is to observe the intensity changes as one passes through the layer.

Mechanism of Formation of Excitation—There are two theories of the formation of excitation processes. The first, suggested by Herzberg is a reaction between atomic hydrogen and ozone:

$$H + O_3 \rightarrow OH + O_2 + 3.3e\nu$$
$$OH + 3.3e\nu \rightarrow OH^*$$
$$OH^* \rightarrow OH + h\nu$$
$$OH + O \rightarrow H + O_2$$

This reaction should theoretically occur with maximum rate at 70 km. in agreement with the observed height by the Van Rhijn method. This theory is attractive also because 3.3 $e\nu$ is just enough to excite OH to the ninth vibrational level. No bands from greater than the ninth level have been observed.

The second mechanism, suggested by Krasovski[5] involves the reaction of vibrationally excited oxygen molecules with atomic hydrogen.

$$O_2 + H \rightarrow OH^* + O$$
$$OH^* \rightarrow OH + h\nu$$
$$OH + O \rightarrow O_2 + H$$

This reaction should occur at about 100 km.

The CARDE Nike-Cajun Experiment

The Purpose of the Experiment—The main objective of the experiment is to establish the altitude of the emitting layer. A secondary objective is to observe the radiation (in the 2.8 to 4.3 μ. region) which has never been seen because of atmospheric attenuation. Knowing the altitude of the emission is an important step in establishing the mechanism of formation of the molecules. This mechanism will give an understanding of the photochemistry of water vapour in the upper atmosphere.

Method—Four lead sulphide filter photometers will be installed in the nose cone. One will observe the strong radiation near 1.6 μ. two will observe the 2.8 to 3.3 μ. region and one will observe the 2.4 μ. region where no OH emission is expected.

In addition, filter photometers will be used to observe a visible OH band

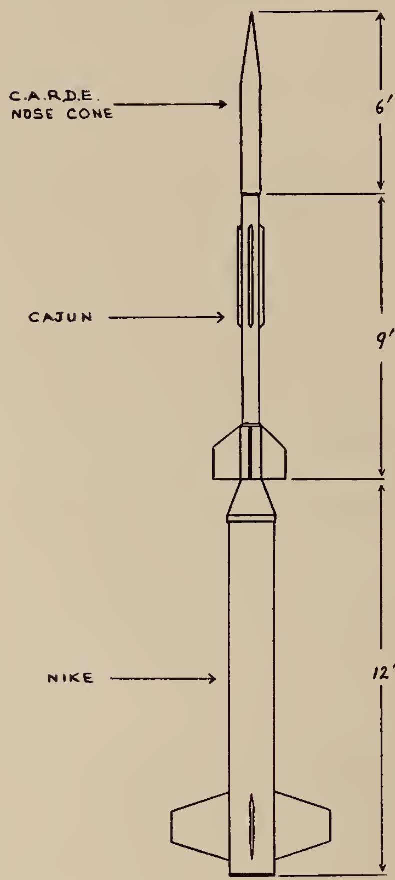


Fig. 1. Nike-Cajun vehicle and nose cone.

centre on 6257A. and to confirm and improve the measure of altitude of the NaD emission at 5893A.

Nike-Cajun Performance and Design Considerations

The design of a rocket test vehicle from the point of, view of configuration and air frame is a field in its own right and can only be mentioned very briefly in this paper. In order to provide a fuller appreciation of the problems however, general considerations will be presented together with specific references to the particular case of the Nike-Cajun for CARDE's I.G.Y. experiments. Figure 1 indicates the general outline of the complete Nike-Cajun vehicle including the nose cone.

Data has been published on the firings of earlier Nike-Cajuns and by extrapolation of the curves and selection of an approximate nose cone geometry it was possible to arrive at a pay load weight for the altitudes specified by the experiment. With a preliminary configuration established estimates of trajectories can now be calculated and initially these can be quite unsophisticated factoring for vacuum conditions. This is justified at this stage as the computations are lengthy and laborious, though computers can be and are frequently used and the geometry itself is subject to change as the design progresses. With the desired trajectory and preliminary configuration known, velocities, dynamic pressures, and altitudes (all against time) are used to calculate the stability of the combination unburnt, at allburnt, and at separation, also the sustainer at unburnt and allburnt. In our case the geometries and centres of gravity, with the exception of the nose cone, and stability margins (the distance between the Cajun sustainer CG and CP) were known for certain U.S.-I.G.Y. nose cones. However, the data did not cover our estimated weight and nose cone length, and for these reasons the stability margin was increased from 1.0 to 2.0 body diameters by re-locating the centre of gravity of the nose cone.

This leads to a re-assessment of the internal layout and more frequently than not a re-arrangement of equipment. This is a period of close liaison between the designer of the experiment, the electronics, instrumentation, and the structure and mechanical engineers, and compromise becomes necessary when limits are reached. At this stage, the structural and mechanical design can be started. The philosophy here is not unlike that followed in the aircraft field though design factors are reduced since the vehicle does not carry a pilot or crew.

Nomenclature varies with countries but for the purpose of this paper it is sufficient to state that limit loads should not cause excessive permanent deformation of the structure and that the structure should collapse at the ultimate load. The limit loads are the maximum loads anticipated during the life of the vehicle and are generally factored by one for the design loads. Under certain considerations the design factor may be less than one.

The loading cases are treated in two separate phases, preflight and flight. The former includes transport and handling. The basic flight loads we considered were boost phase, gusts, separation, aerodynamic pressure, and local inertial loads. In the general case manoeuvre and control system loads, etc., have to be considered. Since weight is at a premium a statistical approach is used in preference to combinations of the worst conditions occurring simultaneously. Another and important design consideration is aero elasticity. This is a phenomena involving the interchange of aerodynamic forces, elastic structural forces and inertia forces. These in turn affect the overall stability of the vehicle and lead to structural vibration and control surface flutter. To overcome these and other problems it is necessary to establish a criterion for stiffness.

In our case, stiffness tests will be conducted at room temperature and studies are in hand to establish the effort, cost, and value of limited tests at flight temperatures. In vehicle design reliability engineering is playing an increasingly important role. Since overall reliability is the product of the reliability of individual components it will be appreciated that to achieve an acceptable figure for the complete vehicle, component reliabilities must be high. The experiment described in this paper involves two vehicles only, not a large production as generally is the case in service missiles. This therefore presents a problem of its own, for two is a very small number to depreciate the cost of the mechanical, structural, electronic and systems test necessary to ensure a high degree of success.

Tests under sea level conditions will be undertaken but the greatest emphasis will be placed on environmental tests, where components, subassemblies, and finally the complete nose cone will be tested under conditions simulating the pre-flight and flight environment. These will include shock, vibration, temperature (not aerodynamic heating), pressure, humidity, moisture. Other environmental tests which will not be done for this vehicle include abrasion (sand, dust, snow, ice), corrosion and fungus. The parameters for these tests are derived from a knowledge of transport handling, motor characteristics, aerodynamic and aeroelastic forces, and the trajectory.

The selection of structural materials and electronic components must take into consideration, not only the loads to be carried but also the environment and the ever-present weight limitations.

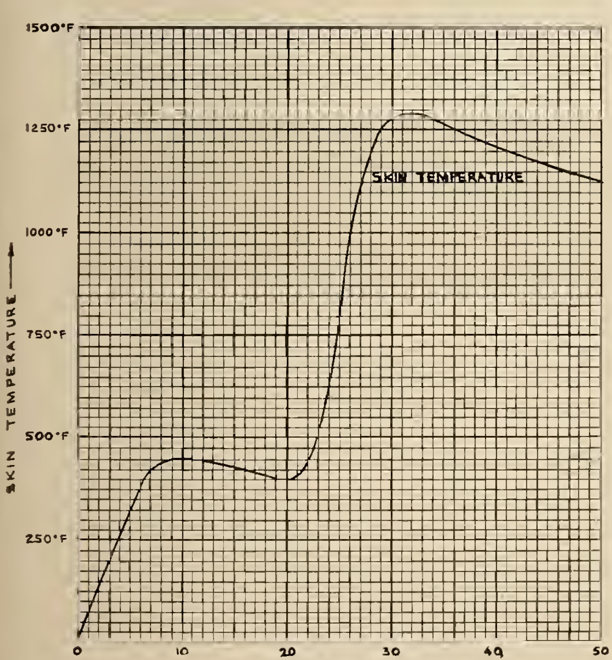
The penalty of a structural failure, while not involving the loss of life, except in the region of the launcher, cannot be overshadowed by the importance of a saving in weight.

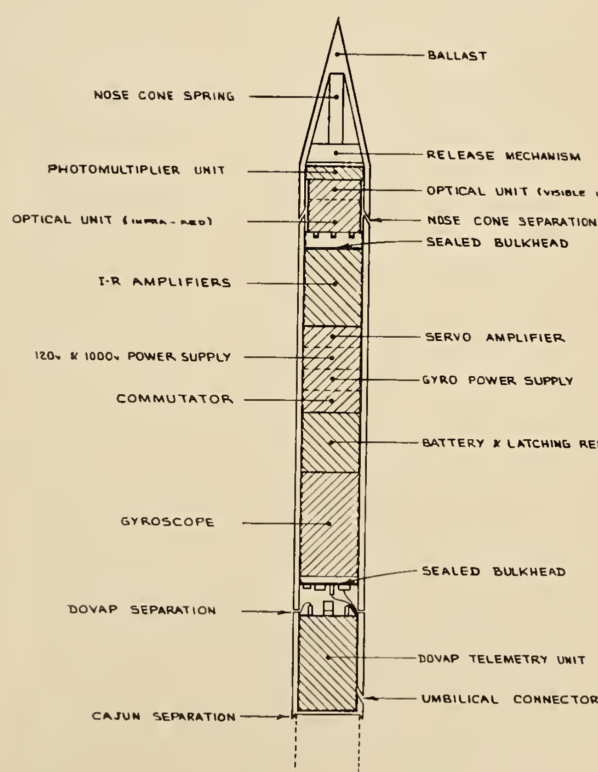
In the selection of material the strength-weight ratio and strength-weight temperature ratio are important parameters. Time is an important factor, for while high stagnation temperatures exist, the interval over which they act is comparatively short. Thin skins with low heat capacity can quickly reach equilibrium temperatures. Thermal conductivity, heat sinks, and the use of suitable insulations must all be considered and evaluated. Thermal co-efficients of expansion for the various materials must be satisfactory or the design must ensure that thermal stresses do not lead to failure of the structure or mechanism. In our case, calculations indicate that the skin temperature may rise as shown in Fig. 2, due to the two phases of boost. The experiment demands an increase of not more than 5°C. black body in certain areas, and this has introduced local problems. Frequently non-magnetic materials are required by the experiment, and this narrows the field of usable materials as well as introducing other complications.

During flight the vehicle is expected to roll at between 1 and 5 revolutions per second. This is not a disadvantage since each radiometer "scans" the sky and the way in which the measured intensity varies can give useful information provided the altitude of the rocket is known.

Fig. 2. Variation of skin temperature with time.

Fig. 3. Layout sketch of instrumented nose cone.





Instrumentation Requirements

Primary Measurements — Infra-red. Ektron plumbide detector cells are available for infra-red measurements in the region 0.4 to above 3 microns, and filters placed in front of the detectors limit measurements to the required wavelengths. The cells have a sensitivity of about 70 microvolts per microwatt and a noise equivalent power of around 6 x 10^{-9} watt in a 5 c.p.s. band. The inherent noise output of the cell is therefore of the order of 0.5 microvolt, and in order to make full use of the cell's sensitivity a high-gain low-noise amplifier is required. The amplifier must handle signals in a total bandwidth of 10 c.p.s. to accommodate the maximum roll of the vehicle (5 c.p.s.) and this bandwidth implies a minimum equivalent noise voltage of 0.7 microvolt at the input. The maximum input to the telemetry system is 5 volts and the minimum resolvable input is 0.1 volt. The noise input of approximately one microvolt must be amplified to about 0.3 volt, a gain of 300,000 or 100 db. In order to make measurements of intensity over a fairly wide range, three telemetry channels are required for each of the four amplifiers. The dynamic range accommodated by a single channel is 24 db. so that the overall dynamic range of measurement is from noise level to 72 db. above noise. The gain of the amplifier from input to the first telemetry channel must be roughly 62 db., to the second 86 db. and to the third 110 db.

Visible light. The expected intensity of radiation at 5893 A. is between 5 x 10^{-13} and 1 x 10^{-11} watts with the aperture used in the optical system. Measurement of this level of intensity is possible with a multiplier phototube, without additional amplification. The range of intensities expected is greater than can be accommodated in a single telemetry channel and two channels must be used. A similar system is used for measurement of intensity of radiation at 6257 A. due to OH radicals. Optical filters in front of the phototube cathodes restrict measurements to the required wavelength.

Secondary Measurements

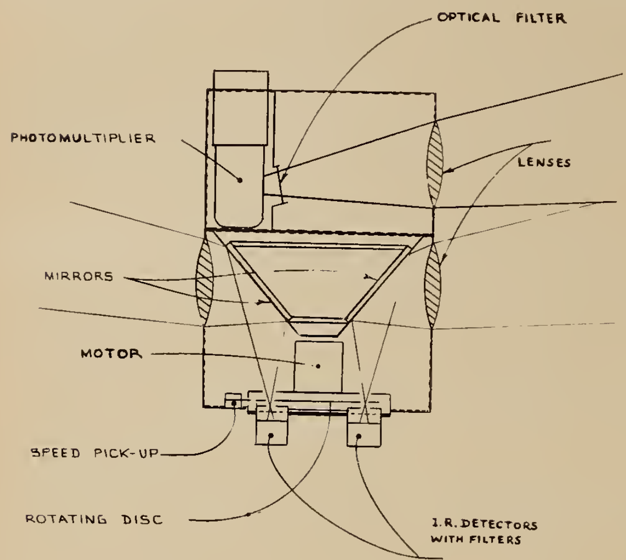
In order that the recorded data shall be meaningful, position and altitude of the vehicle must be determined continuously during flight. The DOVAP telemetry system[6] measures range to the vehicle from the ground station by integration of the Doppler frequency shift of the received carrier. It may be possible to estimate the roll position of the vehicle by reference to the record of measurement at 5893 A. which should show fluctuations at the roll rate. Some other means must be found to determine the altitude of the vehicle, so that the zenith angles of the various radiometer axes may be calculated.

Ancillary measurements are required of the temperatures of parts of the infra-red optical system since detector sensitivity decreases rapidly with rise in temperature.

Recording of data. The measurements will be telemetered to the ground station by the DOVAP system which is briefly described later. The DOVAP unit in the vehicle is self-contained with its own batteries and is in the form of a cylinder 5 in. in diameter, 10 in. long, and weighing 10 lb. As it requires direct connection to the antennas on the Cajun, it is mounted at the rear of the nose assembly.

Design

General. A layout diagram of the nose cone is shown in Fig. 3. The most severe aspect of the environment imposed on the nose assembly is heating of the skin at the lower altitudes. This necessitates a high degree of thermal insulation, despite the short duration of the flight. For this reason the nose assembly is constructed in the form of an inner shell 5½ in. in diameter and an outer skin 7 in. in diameter, the material used being stainless steel in both cases. The space between inner shell and outer skin is filled with fibre-glass. Even with this precaution the lenses and the skin around the lenses would become so hot that infra-red radiation from them into the optical system could exceed in intensity the radiation to be measured. The solution to this problem is to mount the optical unit well forward within the inner shell and to expose the lenses only when the rocket has reached a region of rarefied atmosphere where heating by friction is no longer a problem. This is done by sliding forward a front portion of the skin 40 sec. after launch, at an altitude of about 48 km. The necessity for a double wall and a mechanism for sliding the nose cover limits the space and weight available



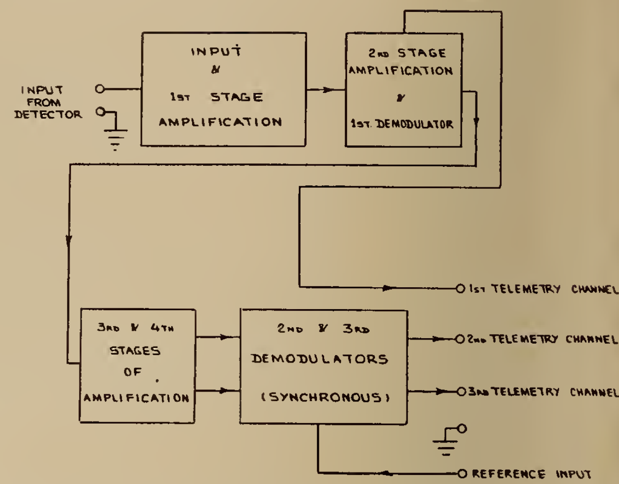


Fig 4. (left) Optical unit. Fig. 5. Block diagram, I.R. amplifier.

for instrumentation, since the payload must be kept low if the required maximum altitude is to be attained.

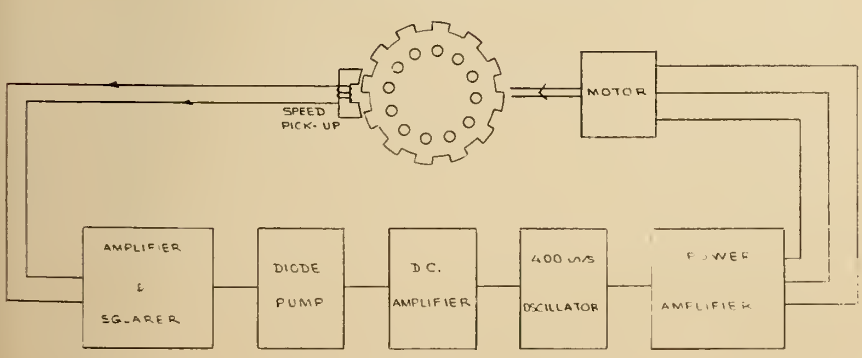
Infra-red measurement. The requirements have been outlined previously. In order to meet space limitations it is clear that the electronic circuits must use transistors rather than vacuum tubes.

Infra-red Photometers. Calculations of semi-conductor noise, and I.R. cell time constants for the detector chosen indicate that the maximum signal to noise ratio is obtained in the region of 750 c.p.s. The equipment is therefore designed to interrupt the optical path at a rate of 750 times a second in order to obtain peak performance from the system. A diagram of the optical unit is shown in Fig. 4. Four quartz lenses are mounted symmetrically around the vehicle axis. Radiation entering a lens from a direction 10° forward of the beam of the vehicle is reflected by a mirror and brought to a focus in the plane of a thin steel disc situated in front of the cell.

Holes are drilled in the disc at a fixed radius and are spaced so that the cell is alternately exposed and obscured for equal intervals of time. A diaphragm with circular iris is mounted between the disc and the cells, and circular irises are drilled in this to limit the illumination of the cell. The disc is driven by a small motor at 3750 r.p.m. and as there are 12 holes in the disc the frequency of the signal from each cell is 750 c/s. The four amplifiers are identical and the block diagram of one of them is shown in Fig. 5. To obtain a low noise factor the first stage comprises a subminiature triode in a cathode follower circuit, followed by a transistor amplifier incorporating negative feedback to stabilize its gain. A second stage of amplification, with negative feedback, raises the level of the signal before demodulation for telemetering. A series tuned circuit between the first and second stages of amplification restricts the bandwidth to 400 c/s. so that noise cannot overload the later stages of the amplifier. Since the noise level is still very low at this point, a simple diode circuit is adequate for demodulation. A third stage amplifies the signal by 24 db. before applying it to the second demodulator which is of the synchronous type and has a bandwidth of 10 c/s. The signal is again amplified by 24 db. in a fourth stage and applied to a synchronous demodulator. All three demodulator outputs are taken to the telemetry system. As the signal level increases above noise the third telemetry channel will be the first to record a signal and the first to overload. Reference signals for operation of the synchronous demodulators are obtained from the servo amplifier described below.

Servo Amplifier. If the small 400 c/s. motor used for driving the chopping disc is driven from a constant voltage source, its speed can vary drastically with change in temperature, change of load due to windage as the air pressure decreases, etc. It is therefore necessary to control its speed by including it in a servo loop[7]. The servo amplifier block diagram is shown in Fig. 6 and comprises a 400 c/s. oscillator and power amplifier and a circuit for measuring the speed of the disc. Near the edge of the disc is mounted a small U-shaped yoke of iron whose magnetic circuit may be completed via teeth cut on the edge of the disc. A total of twelve teeth are cut on the disc so that when it is rotating at the correct speed of 3750 r.p.m. an alternating emf at 750 c/s. is induced in a coil wound on the yoke. This signal is amplified and limited in two stages and applied to a diode pump circuit. If the speed of the disc is too high the current supplied by the pump circuit exceeds the current drain on its storage condenser, and the voltage on the latter increases. This voltage is amplified and used to decrease the current in the transistor of the 400 c/s. oscillator. This reduces the drive to the motor, which then slows down. A reverse effect occurs if the motor speed drops below 3750 r.p.m. The reference voltage for the synchronous demodulators in the I-R amplifiers is the signal applied to the diode pump circuit. The servo has a zero frequency loop gain of 200 and a wide stability margin. Variation of speed of the disc is less than 5% from no load to full load for temperatures between —50°C. and +65°C.

Fig. 6. Block diagram, servo amplifier.



Visible light measurement. Referring again to Fig. 4, the forward part of the optical unit contains two photometer systems for the visible light measurements. The two lenses are mounted in the wall of the optical unit with their axes at right angles. Radiation entering a lens from a direction 10° forward of the beam of the vehicle is brought to a focus at the cathode of a 1P21 multiplier phototube after passing through the appropriate optical filter. The plate load of the photomultiplier is very high (around 100 megohms) in order to achieve the required sensitivity. This high impedance is matched to the lower impedance telemetry circuits by a subminiature triode cathode follower, the full output of which is applied to one telemetry channel. The signal is also divided in the ratio 1:5 before being applied to a further telemetry channel.

Attitude Determination. Two possible methods of attitude determination have been considered. The first uses a gyroscope, the rotor axis of which is set vertically prior to launch and remains vertical during flight. The other method employs a magnetometer which is capable of measuring a component of the earth's magnetic field. The magnetometer is considerably lighter than the gyroscope and takes up a little less room. However its use requires an accurate determination of the strength and direction of the earth's magnetic field and evaluation of the roll position of the vehicle from one of the measurement records.[8] The first choice is therefore the vertically erecting gyroscope, but considerations of overall weight may necessitate use of the magnetometer.

The gyroscope is being developed by a company in Canada from an existing design. The gyro motor requires 11 watts of power at 115 volts, 400 c/s., which must be supplied within the vehicle. Power for starting the motor, about 40 watts, and for the torque motors which erect the gyro can be supplied from an external source since it is only required prior to launch. The angular displacement of the gimbals supporting the rotor are measured by the potentials at the sliders of the potentiometers which are supplied with a reference voltage. The three voltages are telemetred to the ground station; inclination of the vehicle axis to the vertical may be calculated from this information.

The magnetometer which may be used is the heliflex magnetic aspect sensor. Until this unit can be mounted in a vehicle and tests carried out, little is known of its characteristics and accuracy in such an environment. Its power requirement is 20 milliamps at 6 volts, much less than that required for the gyroscope.

The Telemetry System. Telemetered data is transmitted over the DOVAP system and will be briefly described. A block diagram is shown in Fig. 7.

The ground station helical antenna radiates a signal at 38 Mc. to two dipole antennas fixed along opposite sides of the Cajun vehicle. The received signal is amplified and its frequency doubled to 76 Mc. in the DOVAP transponder unit. The signal to be telemetred sets the frequency of a sub-carrier oscillator comprising a multivibrator whose mean repetition rate is 30 kc. This repetition rate is deviated over a range of ±40% by the full range of 0 to +5 volts of the input signal. The output from the sub-carrier oscillator gates the 76 Mc. signal which is then amplified and radiated to the ground station by two transmitting antennas fixed along opposite sides of the Cajun vehicle 90 degrees around from the receiving antennas. At the ground station the received signal is recorded for later analysis.

In order to telemeter all the measurements made in the nose assembly, each signal source in turn is connected to the sub-carrier oscillator by means of a high speed rotary switch or commutator. A synchronizing signal is produced at each revolution of the switch, so that the recorded signals can be de-commutated and identified for analysis. The commutator chosen for this purpose has 60 contacts and the slider is rotated by a 28-volt motor at 10 revolutions per second. Alternate contacts require a small negative bias to assist channel identification when the inputs to several successive channels are zero. Thus 12 channels are required for the I-R measurements, four for the visible light measurements, and three for the gyroscope outputs. In addition it is required to make two measurements of temperature in the vicinity of I-R detector cells and to have an indication of operation of the sliding cover. The synchronizing and calibrating signal requires the use of three channels bringing the total to 25. The remaining five channels may be regarded as spares but use will be made of them to repeat some of the measurements. Since the vehicle may roll at up to 5 c.p.s. and the commutator samples the inputs at only 10 c.p.s. it may be advantageous to use all the spare channels for measurement of radiation at 5893 A. since the roll position of the vehicle is determined from fluctuation in this record.

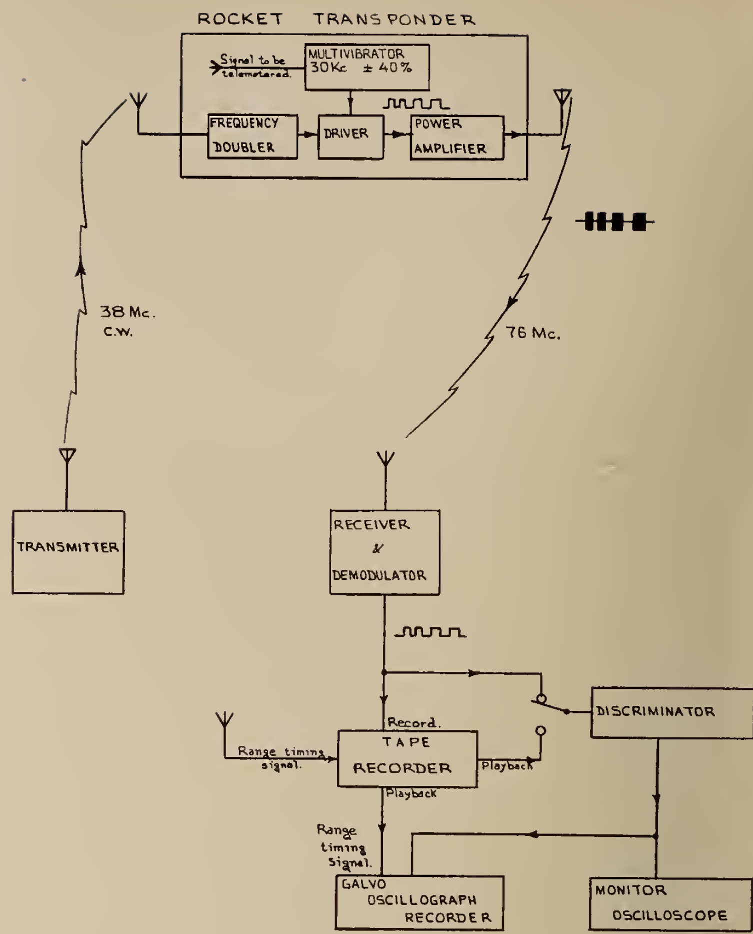


Fig. 7. Telemetry system.

Power Supply Requirements. The transistor circuits operate from low voltages which can conveniently be obtained from batteries. The anodes of the cathode follower, however, require 120 volts positive and the photomultiplier cathodes require a fairly well regulated supply at —1000 volts. The gyroscope also requires a source of 115 volts, 400 c.p.s. Three separate power supply units have been designed to meet these requirements, and all draw their primary power from batteries. The 120 volt and 1000 volt power supplies are similar in design, each employing a transistor relaxation oscillator with a step-up transformer, semi-conductor rectifiers and filter circuits. The gyro power supply consists of a 400 c/s. sinusoidal oscillator and power amplifier.

The battery requirements are summarized in the table of Fig. 8. The cells used to make up the battery pack have silver peroxide and zinc electrodes and are activated by potassium hydroxide electrolyte. This type of cell is characterized by high electrical capacity per unit weight and bulk, and by very good regulation during discharge. Once activated it may stand for 48 hours before use, but must be kept in an upright position to prevent leakage of the electrolyte. For the short duration of the launch phase and flight, leakage is slow enough not to present a problem. There could be a problem with this type of battery at high altitudes, however, since the atmospheric pressure above 32 km. is low enough to permit boiling of the electrolyte. It is therefore desirable to seal off the battery section of the vehicle so that pressure in it does not drop appreciably below atmospheric pressure at ground level. In practice it is convenient to place the forward sealed bulkhead just in front of the I-R amplifier section and the rear sealed bulkhead behind the gyroscope.

Monitoring. It is essential that tests be made to check functioning of the instrumentation right up to the moment of launch. Since such tests may take a considerable time it must be possible to power the electronics from external suplies. It is also necessary to lead in power for starting and erecting the gyroscope. All the circuits required are made through a single multi-way connector called the "umbilical plug" at the end of a cable. The socket for this is mounted at the rear of the nose assembly at a small angle to the vehicle skin. When the rocket is launched the plug will pull away from the socket since it is only retained by the friction of the pins. When the umbilical connection is made it is possible to switch between internal and external battery supplies by means of a six-pole latching relay inside the nose assembly. One method of monitoring the instrumentation is to bring out the single telemetry lead connected to the pole of the commutator. The nose assembly breaks into two parts just in front of the DOVAP unit and provision is made for more detailed monitoring through a connector in the rear bulkhead of the forward portion.

Packaging. Restrictions on space and weight for instrumentation and the high degree of reliability required in a severe environment call for modern techniques of miniaturization and packaging. Each circuit is broken down into small blocks of components which can be interconnected and mounted compactly. After electronic test these blocks are placed in moulds and a compound consisting essentially of an epoxy resin with a mica dust filler is added. When the compound has hardened the blocks are mechanically and electrically stable; the only terminals exposed being the necessary signal and power connections. In the event of failure of a block it may be quickly replaced; normally the old block would be disposed of, but if the faulty component can be located it may be possible to drill it out, replace it, and re-seal the unit with potting compound. After potting units are environmentally tested by subjecting them to the same degree of mechanical shock and temperature, pressure, and humidity change as they may experience during the handling and firing of the rocket. Planning of the package takes into account the requirement for maximum accessibility of units for replacement purposes. The units are interconnected by a cable and miniature connectors, the backs of which are potted in a rubber type compound which imparts mechanical strength and electrical insulation in minimum space.

After final assembly, the entire nose cone is given an overall environmental test to ensure satisfactory performance, and is then complete and ready for firing.

Fig. 8. Battery Requirements

Battery Supply Unit	+6v. Amp.	+15v. ma	−7.5v. ma.	−15v. ma.	−28v. Amp.
Photomultiplier Unit	0.4	1			0.001
Optical Unit	0.01			5	0.25
I.R. Amplifier	0.8	15		15	
Servo Amplifier		4	1	4	
120v. and 1,000v. Power Supply					0.1
Gyro Power Supply		5		5	0.75
Commutator					0.8
Gyro	0.006				
Totals	1.22 Amp.	25 ma.	1 ma.	29 ma.	1.7 Amp.

Acknowledgments

The design and preparation of such a vehicle is the result of the efforts of many individuals, departments and facilities. Further, support from several industries in the form of specialized components and engineering assistance have greatly assisted in this program. In particular I would like to thank Messrs. T. Courtnay, R. Lowe, R. Blake and F. Smith, all of CARDE, for their assistance in preparing this paper.

References

1. Krasovski, V. I. Doklodi Akad. Nauk. **66**, 53 (1949); **70**, 999 (1950).

2. Vallance Jones, A. and Gush, H. P. Spectrum of the night sky in the range 1.2 to 2μ. Nature **172**, 496 (1953).
Vallance Jones, A., Infrared spectrum of the night sky near 10,000A. Nature **175**, 950 (1955).
Gush H. P. and Vallance Jones, A. Infrared spectrum of the night sky from 1.0 to 2.0μ. J. Atmos. Terres. Phys. **7**, 285, (1955).

3. Osherovich, A. L. and Rodionov, S. F. The night sky luminescence in the region 1 to 3 microns. Dokl. Akad. Nauk SSSR **96**, 6, 1159 (1954). DRB Trans T148R.
Pavlova, Y. N. Rodionov, S. F. and Sholokhova, Y. D. Energy distribution in the spectrum of the night sky luminescence Dokl. Akad. Nauk SSSR **98**, 5, 769 (1954). DRB Trans. T255R(i).
Roach, F. E., Pettit, H. B. and Williams, D. R. The height of the atmospheric OH emission. J. Geophys. Res. **55**, 183 (1950).

4. Rhijn, P. J. van. Bull. Astr. Inst. Netherlands **2**, 75 (1924).
Roach, F. E. and Meinel, A. B. The height of the nightglow by the Van Rhijn method. V. J. **122**, 530 (1955).

5. Krasowski, V. I. The infrared radiation of the night sky. Uspekhi Fizichiskikh Nauk **54**, 469 (1954).

6. Somers, H., The DOVAP System in Use at Fort Churchill, CARDE T.L. 1062/57.

7. Park, W. K., Regulated Speed Drive for Infra-Red Chopping Disk, CARDE T.L. 1007/57.

8. Courtney & Moir, Determination of Telescope Zenith Angles in the CARDE I.G.Y. Rocket. CARDE T.L. 1092/58.

An Observatory for the Study of Meteors

F. R. Park, *Senior Research Officer, Upper Atmosphere Research Section,*

Radio and Electrical Engineering Division, National Research Council

EVERY DAY many millions of tiny particles from interplanetary space strike the earth's atmosphere and are consumed by heat generated through friction before they reach the earth's surface. At night, many of these objects produce streaks of light in the sky and are commonly referred to as "shooting" or "falling stars." Until the end of the eighteenth century these streaks of light were thought to be a phenomenon associated with the earth's lower atmosphere and hence were called meteors.

At the beginning of the nineteenth century it was found, by making simultaneous observations from points separated by several miles, that meteors occurred at heights well above the earth's lower atmosphere and travelled with very high velocities. More recent measurements by radio and photographic methods have shown that these heights are in the range of 50 to 75 miles above the earth and the velocities between 7 and 45 miles per second. From a large number of radio observations carried out by the National Research Council, no meteor velocities were found that were sufficiently large to prove that meteors travel in parabolic orbits and come from outer space. It is now well established that meteors are particles of matter from interplanetary space which circle the sun in elliptical orbits, frequently occurring in great swarms. Whenever the earth encounters such a swarm of particles, a strong meteor shower is observed. Many such meteor showers have been recorded. The greatest shower of the past few centuries occurred on November 12, 1833 and marked the beginning of a new branch of astronomy, the study of meteors.

Most of the visible meteors are produced by particles, which range in size from a grain of wheat to a walnut. Billions of smaller particles reach the earth each day but without sufficient energy to produce visible light. Occasionally a very bright meteor or "fireball" is seen and it may have a mass ranging from about an ounce to several pounds. If the fireball is very large it may not be completely consumed in its fiery dash through the atmosphere and some part or parts of the original mass may reach the earth as meteorites. Seeing such a fireball is a rare and unforgettable experience.

The meteor observatory at Springhill, near Ottawa, Ont., was built during 1956-57. This gave the National Research Council improved facilities for its meteor study work in time for the period of the International Geophysical Year.

The question might be asked why man is interested in studying such upper atmospheric phenomena as meteors. To the research scientist it is sufficient if his investigations yield new information about the physical universe, provide him with proof for his theories and permit him to inquire further into the unknown. This is the principal motivation for pure research, and no immediate practical application is necessary or important to the research scientist. However, in the case of meteor research, several practical applications are already apparent for the knowledge that is being gained in this field. By studying the flight of meteors in our upper atmosphere we are able to learn a great deal about the tenuous gas in the outer regions of the earth's atmosphere. A new system of radio communication depends upon the scattering of radio waves from meteor trails to obtain very high frequency propagation well beyond the normal line-of-sight distances. A knowledge of diurnal and annual meteor rates is important to this recent development. Intercontinental ballistic missiles reach heights where collisions with meteor particles are possible. Such collisions are even more important in considerations of space travel by manned vehicles and the maintenance of satellite space stations.

Meteors are the only interplanetary objects that we can examine at close range and meteorites are the only interplanetary material available to us for detailed analysis. Through careful study of how they reach the earth, and of their composition and structure, we may be able to learn what types of material move between the planets and what their past history has been.

Since the end of World War II the National Research Council and the Dominion Observatory have co-operated in carrying out a continuing program of meteor research using radio, photographic, and visual methods. Both continuous wave and pulsed radar have been used to measure range and velocity and to study the diurnal and annual meteor rates. Three-station radar triangulation has been employed to determine the instantaneous positions of meteors as they streak through the upper atmosphere. Combined radar-visual programs are conducted to study the diurnal and annual variation in meteor rates and to correlate the radar and visual data.

From 1947 till the spring of 1957, the greater part of this work was carried out at the Metcalfe Road field station of the National Research Council, a site located about seven miles south from the centre of Ottawa. With the increased building in suburban areas and the extension of the city limits to within a mile of this station it rapidly became unsuitable as a site for meteor observations. The increase in scattered sky light and radio interference seriously handicapped visual, photographic and radar observations. As a result, it was decided that a more suitable location for meteor observing should be established before the beginning of the International Geophysical Year.

The principal factors considered in choosing a new location were those which would ensure satisfactory observing conditions at both optical and radar wavelengths. Furthermore it was important to know that these conditions were likely to exist for the next fifteen or twenty years if the move was to be worthwhile. To obtain good optical observing conditions, the site should be remote from any existing or possible future industrial built-up areas because of reflected sky light, and it should be higher than the surrounding area and reasonably well wooded to avoid difficulty from existing local lights. Although at the wavelength (about 9.25 metres) used in the meteor radar much of the daytime interference is from distant radio signals, it is essential that the site should be free of locally generated electrical noises in order that the best possible records can be obtained. Other factors considered in choosing a new location were access to good roads, and the supply of electric power and water.

A survey was made of the country surrounding Ottawa within a radius of 25 miles and a suitable site was found just off Highway 31 about 16 miles south of the city limits. Thirty-five acres of land were purchased in a tree-covered area behind Springhill Cemetery, about halfway between the villages of Metcalfe and Vernon. The average elevation of the site is 310 ft. above sea level and is from 30 to 50 feet higher than the surrounding country. The trees, though mainly deciduous, are small and quite thick, providing excellent screening against lights from local farmhouses. The distance from the centre of the property to the highway is about a half mile. The highway is in a shallow cut where it passes the cemetery and the sideroad, so that car headlights are well hidden below the horizon.

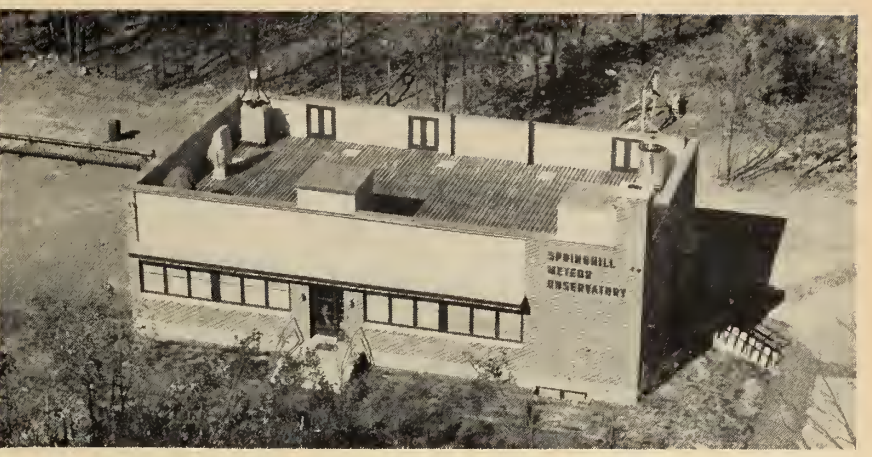


Fig. 1. Main observatory building.

Fig. 2. General view, showing radar antennas.

During the fall and winter of 1956-57, the Springhill Meteor Observatory was built on this site. The observatory is specially designed to provide facilities for the operation of electronic and photographic equipment and for the accommodation of personnel engaged in night-time observations. The building was designed by the architectural firm of Dobush and Stewart, of Montreal, and the construction was carried out by A. Bruce Benson Ltd., of Ottawa. In the early summer of 1957, radio and photographic equipments were transferred from the Metcalfe Road field station to Springhill, and meteor observations were commenced at the new station in July. On November 25, 1957, the facilities of the station were demonstrated to 150 guests and staff members at a small, informal opening reception.

The main Observatory building (Fig. 1) is 62½ feet long and 35 feet wide. The lower floor is constructed with reinforced concrete columns and walls which support a steel superstructure. The roof is a reinforced concrete slab carried on steel beams. One inch of rigid insulation was laid on the slab followed by a built-up tar and gravel roof. Seven special instrument-mounting pads are cast into the roof slab and a duck-board decking is installed which permits traffic over the entire area. A five-foot high parapet surrounds the roof area to protect the observers and instruments from the wind and chance lightning flashes on the horizon. Figure 1 shows four instruments located on the mounting pads. The two with canvas covers are special meteor spectrographs. The other two instruments are auroral all-sky cameras specially designed for use during the I.G.Y. The small hut in the centre of the front parapet provides a shelter for the operators and a place where they can prepare their records. Since the photograph was taken, a three-foot diameter, clear-plastic dome has been installed in the roof of the observers hut. From here a watch can be kept of the night sky during an observing period.

The exterior treatment of the observatory is red brick with the front and rear parapets covered with grey asbestos board, providing a pleasing appearance to a rather difficult architectural subject. The interior of the building provides operating space for meteor radar equipments, photographic darkrooms, offices, a fully equipped lunch room, and dormitory accommodation for the use of staff members on night duty shifts.

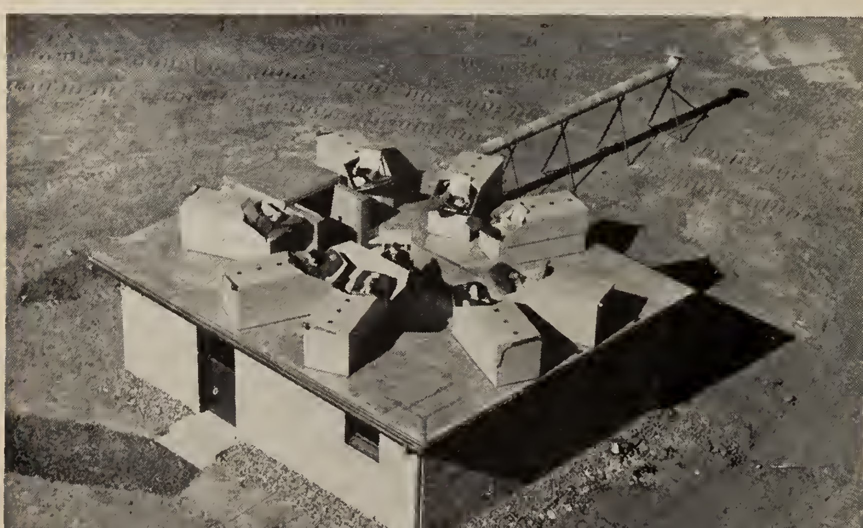
Two pulse radar equipments, operating on a wavelength of approximately 9.25 metres and equipped with special display units and cameras to obtain a continuous photographic record of the meteor echoes, are installed at the Springhill Observatory. One of these radars was designed specially for the I.G.Y. program and operates continuously on a 24-hour basis. It has a peak power output of 20 kw. and incorporates special features to insure stability of its operating characteristics. Separate transmitting and receiving aerials using crossed dipoles spaced 0.4λ (where λ is the operating wavelength) above elevated conducting groundscreens, produce stable omnidirectional radiation patterns. These antennas can be seen in the upper left and lower centre of Fig. 2. The groundscreens are located above ground by approximately 3 feet so that the effective height of the antenna is not altered by the accumulation of snow on the ground. The ground-screens consist of 6-inch square galvanized wire mesh, joined by compression sleeves and stretched over a framework of 2-inch by 6-inch cedar planks supported on 4-inch square cedar posts. The posts, which are bolted to the plank framework, rest on 12-inch square by 4-inch thick concrete blocks set in crushed stone. The diameter of the ground-screens is 105 feet, being sufficient to control and stabilize the radiation pattern down to within a few degrees of the horizon.

The second meteor radar, operating on the same wavelength but with simple horizontal-dipole antennas, was built some years ago and was moved to Springhill from the Metcalfe Road field station. It has a peak power output of approximately 400 kw. and is operated during special observing periods. During the I.G.Y., full-scale meteor observations are being carried out on 81 specially selected dates.

From 1947 to the spring of 1957, the National Research Council had established facilities for visual meteor observing at the Metcalfe Road field station. The visual station consisted essentially of eight reclining seats arranged in a circle and facing outward. The recorder sat in the centre and a canvas windscreen surrounded the whole to provide some protection against the wind and low level lights.

A new visual platform (Fig. 3) was constructed at Springhill during the summer of 1957. The experience of conducting visual meteor programs during the previous ten years was utilized to make the new unit as efficient as possible. Raising the level of the observers above the ground avoids some of the problems of dew formation, provides for centre access to the visual platform without disturbing the observers, and for space below to permit storage of cold weather equipment and the installation of an oil-fired forced-air furnace. Special cubicles have been built for the eight observers to provide greater protection against cold weather. Heated air from the furnace is piped to each observing cubicle and to the recorder's position in the centre. Since the photograph was taken, a pipe railing and a canvas windscreen have been installed around the platform. Buried cables provide for electric service to the building, and the necessary electronic and control circuits between the visual platform and the observatory.

Fig. 3. Visual observation platform.



The Springhill Meteor Observatory serves as a field station for the Upper Atmosphere Research Section of the Radio and Electrical Engineering Division. The radio work is carried out entirely by this section while the photographic and visual programs are conducted with the co-operation of the Stellar Physics Division of the Dominion Observatory. As a site for carrying out photographic and visual observing programs, the Springhill Observatory has proved to be a very great improvement over the Metcalfe Road station. Since there is little or no local radio interference, the radar records are superior to those obtained in the past. It is anticipated that this station will become the headquarters for most of the meteor research programs to be conducted in the Ottawa area for several years.

Tunnelling Saskatoon's 14th Street Storm Sewer

D. R. Graham, M.E.I.C.,* and N. L. Iverson, M.E.I.C.†

THIS STORM sewer serves an area of approximately 800 acres in east Saskatoon. There is no natural surface drainage for this area despite its proximity to the South Saskatchewan River. The required depth of sewer, general soil conditions in the area and the necessity of disturbing surface traffic and shallower water and sanitary sewer services as little as possible indicated the desirability of installing the sewer by tunnelling methods.

Soil Conditions

The design of the tunnel was started in early 1950 and a number of churn drill holes were put down along the proposed route late that year. The holes were drilled to obtain a general idea of soil conditions and no samples were taken. The general geological conditions in Nutana (the area lying on the south and east side of the South Saskatchewan River) are alluvial deposits overlying a dense glacial till. The alluvial deposits are extremely variable in nature, and in depth (see Fig. 1), but they generally consist of a layer of fine silty sand from 0 to 40 ft. thick overlying a firm blue clay of medium to high plasticity. The depth of sand varies very erratically within a short distance, the contact between sand and clay often sloping at a 1:1 gradient. The water table varies but is generally about 15 to 25 ft. below the ground surface. The quantity of seepage encountered in excavations in the sand below the water table is not great but it usually causes the sand to cave or run. The glacial till underlying the alluvial clay is generally a dense clay but it contains frequent lenses or layers of fine to coarse water bearing sand. Table I gives the results of routine classification tests made on samples of alluvial and glacial clay obtained from the area in 1952.

Although the required tunnel depth was somewhat less it was decided to tunnel about 50 ft. below the ground surface with the hope of avoiding sand for most of the tunnel length.

Hand Excavation

It was decided to use 60 in. diameter tunnel liner rather than 54 in. to provide more working room at a slight additional cost. Ten-gauge Armco tunnel liner plate was used throughout. Work started 1 June, 1951 using conventional hand tunnelling methods and digging the blue clay with an air spade. Material was transported in earth buggies pushed by hand on tracks installed on the tunnel invert.

This paper describes briefly some of the troubles encountered in attempting to tunnel through overburden deposits and the methods used to overcome them. The greatest difficulty was due to running ground in the form of saturated silt and sand. The various techniques used, such as concrete grouting, chemical stabilization, electro-osmosis, etc. are described briefly. Two types of mechanical shields are described and their relative advantages and disadvantages discussed.

Progress for the first 740 ft. was excellent, about 3 rings (4½ ft.) were regularly installed per 8-hour shift. The first trouble was encountered at Sta. 7+42 in mid-December, 1951. Work stopped at noon Saturday and when the workmen returned on Monday they found the tunnel completely filled with sand, water, and clay for a distance of 12 ft. and partially filled for a distance of 60 ft. from the face. Apparently the clay cover gradually yielded and gave way, allowing the water-bearing sand to pour into the tunnel. The material in the tunnel was composed of what appeared to be a very fine silty sand mixed with chunks of highly plastic alluvial clay. Tests on samples revealed that the fine silty "sand" was actually silt. Four samples were analyzed in a hydrometer test and the average test results were as follows:

- Medium sand 0-1%
- Fine sand 9-27%
- Silt sizes 59-66%
- Clay sizes 11-29%

The task of removing the material in the tunnel was started immediately. Partial bulkheads were used to stop further flow of silt into the tunnel. It was found that little or no progress could be made by this method. The tunnel was bulkheaded off and a shaft started a few feet beyond the face of the tunnel. A cavity 18 ft. deep and 12 ft. in diameter was found immediately below the frost line.

At this time six churn drill holes were put down along the tunnel route. The first four were spaced at 20 ft. intervals starting about 10 ft. from the tunnel face. Their logs are included on the profile, Fig. 1, and the data for Table I were obtained from these tests. The logs indicated

*Waterworks Engineer, City of Saskatoon.
†Prairie Farm Rehabilitation Administration, Saskatoon, Sask.

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that, while the tunnel would soon be beyond the immediate trouble spot, the depth of sand and silt varied erratically and more difficulties could be expected at frequent intervals. In many places where difficulty was encountered a portion or all of the tunnel face was in firm blue clay, but the clay cover was insufficient to support the weight of cohesionless sand and water above.

The shaft was successfully completed and excavation again attempted in the tunnel. It was evident that a different procedure would have to be used.

Freezing Method

An attempt was made to freeze a horizontal curtain over the tunnel face by using dry ice packed in two-inch pipes six feet long and spaced on 12-in. centres above the tunnel. This was partially successful and two rings were installed. The method was slow (about 36 hours freezing time was required) and further attempts at freezing were unsuccessful, probably because even a small movement of ground water towards the tunnel face reduced the effectiveness of the freezing. Consequently this method was abandoned.

Use of Poling Plates and Grout

About this time an attempt was made to support the silt above the tunnel face by jacking sheet piling horizontally about three feet above the tunnel face. This attempt was unsuccessful because of the fluid nature of the silt. Up to this time pressure grouting had not been attempted, mainly because the type of soil giving difficulty was silt and very fine sand. Grouting of material finer than coarse sand is usually not successful because the grout will not penetrate the voids in the material.[1] However it was attempted here as a matter of expediency and with the hope that grout would fill some of the voids left by the caving material. A converted steam pump was used and driven by compressed air. A cement-sand mixture of 1 part cement to 2 parts sand with 4% bentonite added was used. Some progress was made but not sufficient to warrant any optimism; at that time the value of high pressures and the necessity of continuing to grout until pressure became effective was not appreciated.

After consultation with officials representing the manufacturer of the liner plate it was decided to use interlocking steel poling plates five feet long over the top of the tunnel. A 50-ton capacity power-operated hydraulic jack mounted on a four-wheeled carriage was built to press the poling plates forward as the tunnel advanced.

Table I. Results of Classification Tests

		Density lb./cu. ft. Wet	Density lb./cu. ft. Dry	Water Content %	Liquid Limit	Plastic Limit	Plasticity Index	Unconfined Compressive Strength lb/sq. in.
Alluvial Clay	No. Tests	(62)	(62)	(64)	(11)	(11)	(11)	(11)
	Average	114	85	34	57	20	37	17
	Range	108-120	79-99	23-43	36-78	17-24	12-55	6-26
Glacial Clay	No. Tests	(14)	(14)	(14)				
	Average	132	118	12				
	Range	106-142	93-128	7-17				

A power hoist was installed at the shaft so that earth buggies could be brought up and dumped. At the same time a high-pressure air-operated grout pump with a booster feature capable of producing a discharge pressure of 200 lb. per sq. in. was designed and built.

By using a combination of grouting and poling plates twelve rings (or 18 ft. of tunnel) were installed in six weeks. The poling plates gave some protection but the tunnel face had to be left partially open for a considerable time while they were manipulated. Grout also presented a serious obstacle to their advance. However the grouting procedure worked better than had been expected, despite the fineness of the sand and silt. The grout, when under sufficient pressure, forced its way into the sand in sheets, and provided some overhead support. The quantity of water flowing into the tunnel was never a serious problem if the pressure head could be coped with. It was decided to abandon the poling plates and proceed with pressure grouting alone. After considerable grouting it was possible to remove the jacking heads and abandon the poling plates. By this time they were badly bent from being jacked through grouted material.

Grout Only

Tunnelling was continued by grouting with a cement-sand-sawdust mixture of 1:2:2 proportions in combination with a small amount of bentonite. By applying plenty of pressure this mixture could be forced into the silt where it would remain stable for from five to ten hours. Then the material would get progressively wet, start to spall in large pieces, and finally start to slowly squeeze into the tunnel. If bulkheading was not installed at this stage it was invariably followed by a rush of silt and water under considerable pressure which could not be controlled until the tunnel was completely filled for some thirty feet back from the face and partially filled for a much greater distance. This unfortunate circumstance occurred a few times until enough experience was gained to know when to stop excavation, bulkhead the face, and regrout.

An objectionable feature of pressure grouting is that invariably the bulkhead is subjected to very high pressures which distort the tunnel liner and make grade and bearing very difficult to control. In all cases where silt pockets were overcome with pressure grouting the grade and bearing were erratic and compensations had to be made. However the grouting procedure worked quite well and by 8 January, 1953 fifty-nine rings (88½ ft.) had been installed and the tunnel was through the silt pocket.

The next 700 ft. of tunnel was installed with only one silt pocket being encountered and this was stabilized with a single grouting.

Use of Splinter Boards

It was found that, where loose or spalling clay was encountered, a semi-circular shield could be quite easily installed and was very useful where the hydrostatic pressure was low. This shield was constructed by driving in 3 or 4 ft. lengths of 2 in. by 4 in. fir. A levering tool was made to lift the heel of these boards up, and pull them back, so that the rear ends rested on the perimeter of the tunnel liner. If properly placed these did not interfere with the installation of the liner plate section and fairly rapid progress could be made.

Attempt at Electro-Osmosis

Another bad silt pocket extending for about 80 ft. was encountered on 9 March, 1953. In an effort to find a quicker and cheaper method of control an attempt was made to use electro-osmosis.[2, 3] Four cathodes were

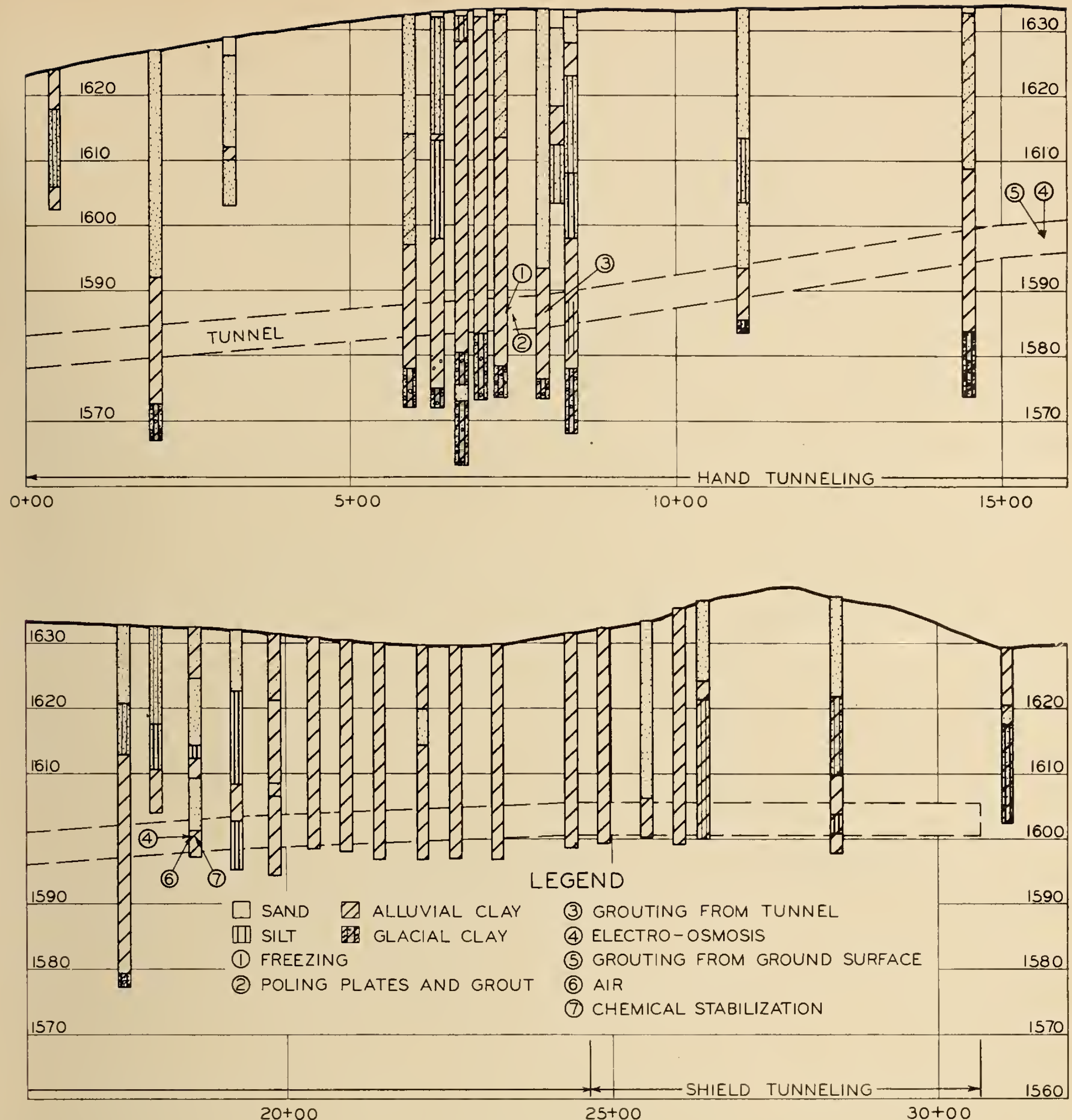


Fig. 1. Soil profile.

put down from the surface about 20 ft. ahead of the tunnel face. The tunnel liner was used as an anode, and current from two 500-amp. welding generators in series was supplied for four days. This did not result in any improvement in conditions at the face of the tunnel probably due to the coarseness of the unstable material.

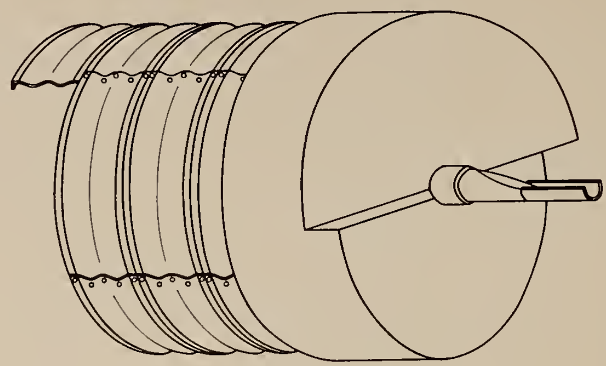
Grouting from the Surface

Pressure grouting was again used to overcome the difficulty but this time the grouting was done from the surface. Two-inch diameter pipes were put down at 10 ft. intervals and grouted. This worked very well, and by 9 May, 1953 the tunnel had reached Sta. 15+66. A shaft was put down at Sta. 15+40 but no further tunnel work was done until 4 Dec., 1953.

Work progressed well until 27 Dec., 1953 when a bad break occurred at Sta. 18+52. At the time of the cave-in the face of the tunnel was mostly in clay with only the upper foot or two in sand. Over 350 bags of cement were used in grouting before any results were obtained. At this point the surface of the street raised noticeably and a crack appeared in front of, and at right angles to, the tunnel. A grout pressure of possibly 100-150 lb. per sq. in. was being used. The tunnel invert at this point was only about 33 ft. below ground surface so that from this point it would be unlikely that sufficiently high pressures could be developed to effectively grout the sand.

Use of Air

An attempt was then made to displace the water in the sand with air pressure. Four two-inch pipes were put down about 25 ft. in front of the tunnel. Air at 20 lb. per sq. in. pressure was supplied for forty-eight hours. An attempt was then made to work at the tunnel face. While there was some apparent decrease in the water content of the sand the results were not sufficiently good to make any progress, and the idea was abandoned.



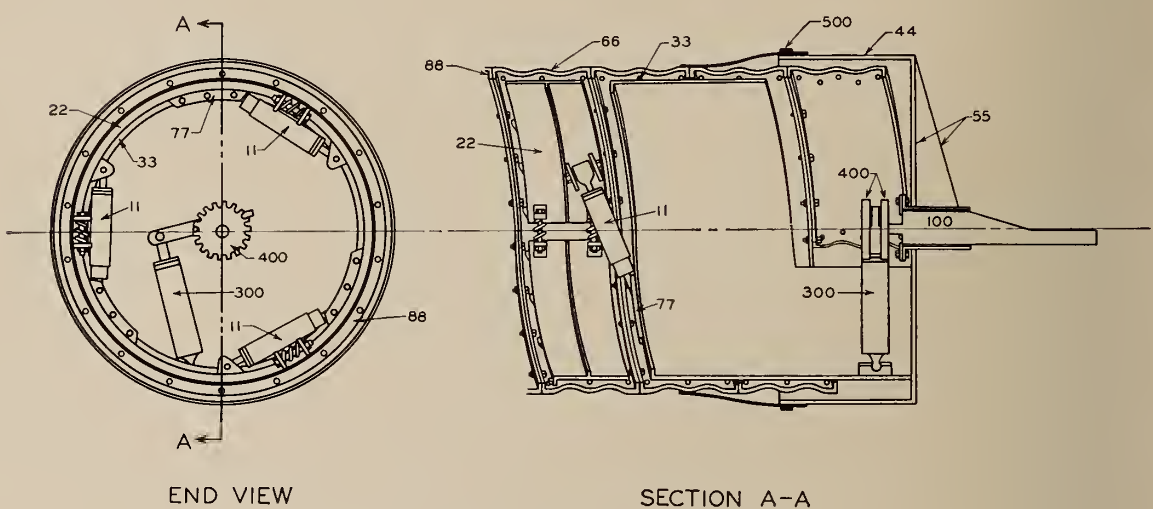


Fig. 2. Sketch of rotary auger type shield.

11 Driving rams
22 Expanding circular shoe
33 Inner shell of shield
44 Outer shell of shield
55 Cutting edge of shield
66 Spiral bolted liner plate
77 Jack attachment to inner shell
88 Liner plate flange
100 Steering bar
300 Hydraulic ram
400 Reversible ratchet assembly
500 Corded rubber seal

Electro-Osmosis

A sample of the sand was taken and tested. The sample was a silty fine sand; over 65% was between the 100 and 200 mesh sieve, with about 15% finer than the 200 mesh sieve. Thus of the various methods of soil stabilization and de-watering the only methods that could be expected to be successful would be a well point vacuum system or the use of compressed air.[4] The soil would be too coarse for electro-osmosis, too fine for ordinary gravity well point systems, and on the borderline or too fine for chemical soil stabilization. The use of compressed air was considered as a last resort because of its probable expense and lack of experienced labour. The use of a well point system from ground level would require two stages due to the lift, and consequently would require an open cut. This was considered as extremely undesirable because of the interference it would cause with traffic and existing water and sewer services at shallower depth.

It was decided to attempt one or more of the methods that were of doubtful applicability, such as electro-osmosis or chemical stabilization. Electro-osmosis was attempted first because the equipment was available and it was the less expensive alternative. The tunnel was made the cathode, and two 1½-in. steel pipes driven into the face of the tunnel for a depth of about 15 ft. were used as the anodes. The anodes were covered for the first 10 ft. with rubber hose so that the current would flow from the ends of the anodes to the sides of the tunnel. The idea was to assist natural drainage into the tunnel and away from the face of the tunnel. The generator output was 125 amp. at approximately 90 volts. After three days of continuous operation the face was opened. It was found that some drying had taken place near the anodes but that the electro-osmotic pressure had not been enough to stabilize the silty sand.

Use of Chemical Solidification

Experiments were made in the laboratory using sodium silicate and various acids in order to produce a suitable gel in the sand. It was found that a solution of 32 parts water, 7 parts sodium silicate, and one part glacial acetic acid produced a firm gel with a setting time of approximately 30 minutes.

It was found that the gel, when injected, stabilized the sand to a considerable extent but did not have sufficient mechanical strength to withstand the head of water above the tunnel. It was often necessary to use air spades to remove grout-hardened sand and the vibration hastened the squeezing-in and rupture of the tunnel face.

It was therefore necessary to consider the use of a calcium chloride solution with the sodium silicate solution. These two chemicals react to form a crystalline solid with considerable mechanical strength. Considerable experimentation was necessary in order to establish the correct and economical amount of chemicals to use. Solutions of 10 gallons of sodium silicate to 10 gal. of water and 40 lb. of calcium chloride to 20 gal. of water gave the best results. Also it was necessary to construct an injection device. This was made from two small steam pumps connected to a ⅜-in. copper tube inside a ½-in. pointed pipe with holes near the point so that the two chemicals did not mix until they reached the discharge end. The procedure was to pump in five to eight gallons of sodium silicate solution and then an equal quantity of calcium chloride. A small jet of compressed air was used to agitate the calcium chloride solution and ensure good mixing. This gave good results although it was quite expensive. The approximate cost for chemicals alone based on the amount used for this portion of the tunnel was $80.00 per foot. The cost of cement grout often exceeded this amount so that it cannot be considered an excessive cost for overcoming fairly short stretches of difficult tunnelling. However, the use of chemical solidification did not prove successful for routine tunnelling work. Under the existing 20 ft. head of water the tunnel face would often spall or break out, making it difficult to replace the bulkhead before the sand and water began pouring into the tunnel. It was also quite slow as a routine procedure. Consequently it was abandoned except as an aid to mechanical shield tunnelling.

Rotary Auger Type Shield

The last 600 ft. of the tunnel was driven using two types of shields. First a rotary auger type shield was tried. This was designed and built in January 1955. The essential features are shown in Fig. 2 and two photographs of the shield in operation are shown in Figs. 3 and 4. The idea was to bolt the tunnel liner in a continuous spiral, rather than in concentric rings. The shield consisted of a double-bitted auger with an 18 in. lead and 9 in. pitch. The auger was 64 in. in diameter and was rotated by means of three power-operated hydraulic jacks with 3 in. bores and 12 in. strokes set tangentially and spaced at 120° intervals on the inner shell of the shield. A continuous expanding shoe made in three segments was used to grip the bolt heads in the liner plate flange. The shaft end of each jack was connected to one segment of the shoe. In this way even pressure was exerted on the liner plate when rotating the shield. A corded rubber seal was used to prevent silt from flowing in between the shield and tunnel liner.

Steering was controlled by a truncated outer shaft 6 in. in diameter and five feet in length. This steering bar could be rotated with the auger when no change in direction was required, or held stationary when making a correction in either grade or bearing.

The shield was powered by a 3 h.p., 3600 r.p.m., 3-phase, 220-volt motor driving a hydraulic pump through a 3 to 1 speed reducer. A hydraulic pressure of 2500 p.s.i. was used. Suitable fourway valves were used for reversing; these valves also had a neutral position.

Rotation for one segment, 90° of rotation, required approximately fifteen minutes and required seven strokes of the rams. Ten segments in an eight-hour shift was considered normal progress. This corresponded to an advance of 45 in. per eight hour shift as compared to 54 in. for good hand tunnelling.

In hard blue clay or semi-stable silt this machine worked very well. It required a relatively small amount of power and did not exert excessive strain on the tunnel liner. No extra bracing was necessary as far as the liner plate was concerned.

Fig. 3. Auger type shield installed.

Fig. 4. Auger type shield showing expanding shoe and jack.

Two hundred and thirty-five feet of tunnel was completed with this machine.

Steering presented some difficulty as the tendency was for the machine to rise. An analysis of the forces acting at the cutting edges will show that this can be expected. However this problem was overcome by lengthening the steering bar and restricting the flow of earth through the opening on the up cutting side of the machine. Hinged gates were installed on these openings and were made adjustable.

The shoes providing forward thrust gave some trouble and on one or two occasions bent the liner plate flange very badly. This difficulty was never adequately solved although there are one or two ways it could be done.

The third and greatest difficulty was the rubber seal at the back of the shield. It was two failures of this seal that was the deciding factor in abandoning this type of shield in favour of a push type machine.

Since that time however a type of seal consisting of metal segments hinged at one end and overlapping each other has been evolved. This should effectively solve the seal problem.

Specially designed liner plate, having the correct forward spiral and counter-sunk threaded nuts, should be developed and used for this type of shield.

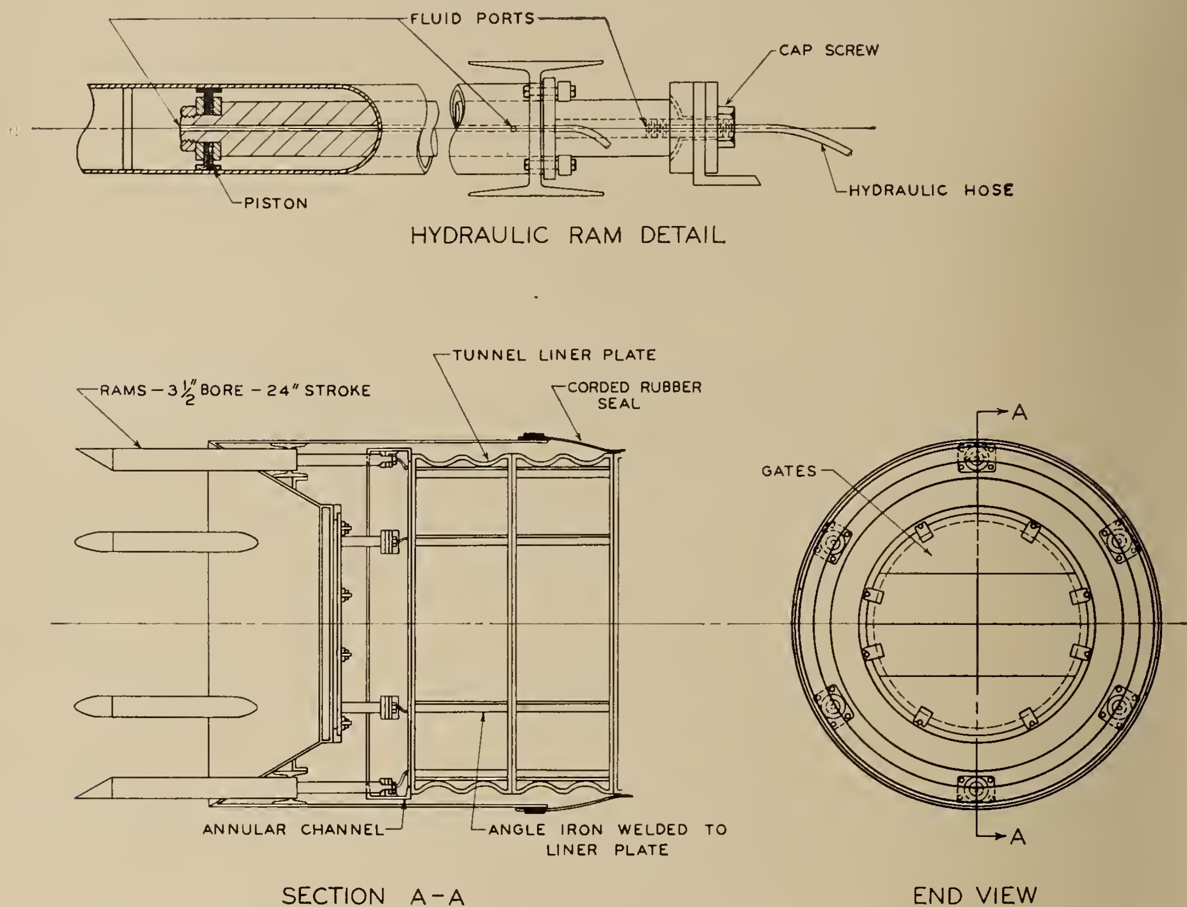


Fig. 5. Sketch of push type shield.

Experience with the Push Type Tunnelling Shield

After two failures of the seal on the rotating tunnelling machine and with the most difficult portion of the tunnel still to be completed it was decided to abandon that method for the time being.

A push type shield of the type shown in Fig. 5 was designed and built. A single outside shell of ⅜ in. mild steel plate with a corded rubber seal at the rear was used. The front 30° cone reduces from the cutting edge of 64 in. to a centre opening of 42 in.

Originally eight doors, hinged at the centre and latched at the periphery of ¾ in. bolts with thumb nuts and slotted tongues, were used (Fig. 6). It was found that the centre bar offered considerable resistance and it was subsequently removed, and four gates extending across the opening were substituted. This seemed to work much better.

Forward motion was effected by six hydraulic rams having a 24 in. stroke and 3½ in. bore. Hydraulic pressure used was 3000 p.s.i. An annular channel served to distribute pressure against the tunnel liner, and the shaft ends of the six jacks were connected to this ring by means of sockets which allowed some swivel action.

The liner plate had to be reinforced by 2 x 2 x ⅜ in. angle iron opposite each jacking point in order to withstand the thrust. This required considerable extra labour and added substantially to the expense.

The same power unit previously described was used. However, it was now working at considerably higher pressure, and maintenance became quite costly. In order to prevent excessive delay a spare unit was kept in readiness.

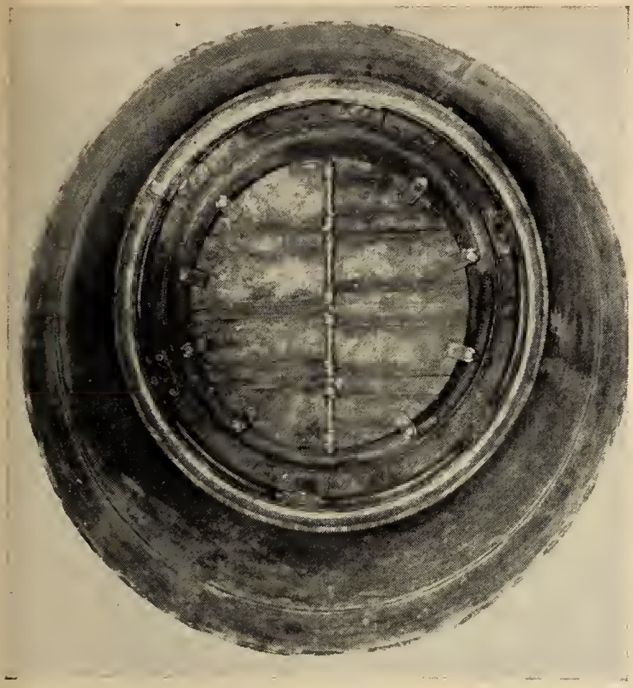


Fig. 6. Push type shield as constructed.

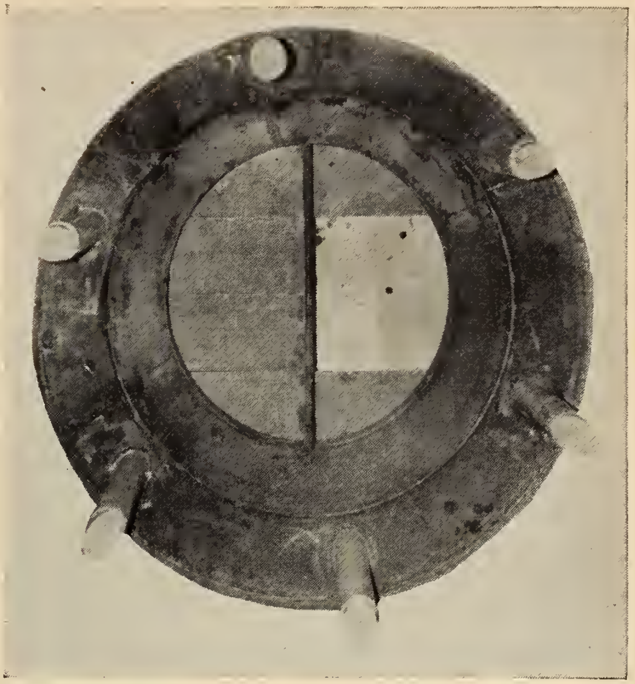


Fig. 7. Front end of push type shield.

The seal at the rear of the shield gave some trouble and considerable leakage occurred. This was never serious and it was possible to make continuous progress. Steering was a difficult problem with this machine also. The tendency was for the front end to go down. This is understandable when one realizes that all the earth excavated by the bottom one-third of the cutting edge must be lifted in order to pass through the opening while that excavated by the top portion of the cutting edge moves down.

An attempt to steer by shutting off the oil supply to the top rams resulted in serious loss of power.

This had been forseen to some extent and the machine was designed with the rams projecting through the front end of the machine about 18 in. with the ends of each ram terminating in a 30° inclined plane (Fig. 7). By rotating the body of the ram the inclined plane tended to exert radial force on the machine. It was found that bearing and grade could be controlled quite effectively by this means. It also materially reduced the overall required length of the shield.

Progress with this type of machine was 48 in. per shift. Under favourable conditions this could probably be considerably increased.

Some mention should be made of the use of sodium silicate — calcium chloride solutions for soil stabilization in connection with shield tunnelling.

In installing the push type machine the rotary machine had to first be removed. This was accomplished by first sinking a shaft 12 ft. wide and 14 ft. long, 38 ft. deep in wet, fine, running sand. A wood cribbing of double spruce 2 in. x 8 in. was first put down 12 ft. Inside this crib 30 ft. interlocking steel piling was driven to form a cofferdam. Excavation was then proceeded with until silt and water began to boil up from the bottom of the excavation.

Several barrels of sodium silicate grout were then injected through small holes cut through the steel piling at about 3 ft. intervals. Grout was also injected inside the cofferdam. Excavation was then proceeded with and small additions of grout were injected whenever boiling recurred. This was usually at from four to twelve hour intervals.

By using this method it was possible to remove the rotary machine and install the push type without a great deal of difficulty. The excavation was then partially backfilled and the piles pulled.

Conclusions

In the course of construction of this tunnel many different procedures were used and under certain conditions most of them had some value.

Concrete grouting was found to be useful in coarse sand or gravel or in cohesive clay at sufficient depth to obtain good compression. Under these conditions the water content of the soil can be reduced to the point of good stability. Work can then proceed until the water re-infiltrates. This was usually a matter of three to twelve hours under the pressure heads encountered on this project.

Chemical grouting was useful in fine sand and silt and as an aid in shield tunnelling. The grout did not have sufficient strength to withstand high water pressures and had a useful life of only a few hours under pressure.

Electro-osmosis was unsuccessful, probably because the type of soil was too coarse and considerable water pressure existed.

Short wood piling of 2 in. x 4 in. fir driven to form a short semi-circular shield proved very useful in combating loose soil or spalling clay but was of no value where water pressure was high.

Freezing proved too costly and slow, although for short distances where cost is not a predominant factor it can be very effective.

Tunnelling with a mechanical shield proved to be the most effective method of coping with unstable soils. By this means success is assured even under the most adverse conditions and progress is nearly as rapid as with hand tunnelling. The cost of constructing a shield for a five-foot bore

(Continued on page 87)

Canada is Host to the

World Power Conference Sectional Meeting

To be held 8-11 September 1958

Queen Elizabeth Hotel, Montreal, Quebec

FOR THE FIRST time in her history Canada, one of the world's great producers and consumers of power in all its forms, will act as host nation next month (September) to a Sectional Meeting of the World Power Conference.

The event is expected to attract more than 1,000 scientists, engineers, economists and other experts. Converging on Montreal from some 50 different countries, they will gather to consider "Economic Trends in the Production, Transportation and Utilization of Fuel and Energy".

The Technical Sessions

Within that framework, roughly 150 technical papers will be presented, Canada contributing nearly 20 of them. Pre-prints of these, along with general reports summarizing them by groups, have been mailed in advance to all delegates, in order to keep as much time as possible available for discussion and debate on selected topics.

Sessions, all to be held at The Queen Elizabeth Hotel in Montreal, will open on Monday, September 8. That morning will be devoted to hydraulic energy, covering both system planning and design and operation. In the afternoon delegates will discuss the more general aspects of hydraulic energy, including economic trends in power development.

Tuesday morning's sessions will consider production of thermal energy from coal, oil and gaseous fuels, and delegates will turn their attention that afternoon to nuclear energy and nuclear fuels.

On Wednesday morning, September 10, sessions on transportation will open, with global trends in electiic transmission and in carriage by rail, water and pipeline all being examined.

Sessions on utilization will begin on Wednesday afternoon, as conference delegates meet to review the use of power in industry and commerce. They will continue the following morning, Thursday, as the four-day meeting ends with discussions covering utilization of power on the farm, in the home, and by railways and airlines.

Procedure for conducting the technical sessions will be as follows:

At least 48 hours before the Conference anyone wishing to submit formal discussion must submit a brief summary of what he proposes to say, limiting his remarks to the points listed in the general reports.

The chairman of the session will open the proceedings by announcing the topics chosen for discussion, and outlining the rules of debate. He will then call on selected speakers who have submitted summaries of formal discussion.

Discussion will be carried on in French and English, for which simultaneous translation facilities will be provided. If time permits, the chairman will then call on other speakers who are prepared to limit their remarks to the points listed in the general report, after which he will call on the general reporter for a summary.

If enough interest is shown, moreover, informal gatherings may be arranged for those who want to take up more fully a topic associated with any particular session. Announcements of these gatherings will be carried in the daily bulletin, to be issued each morning during the meeting.

Associated with the conference will be a number of study tours. One of these will enable delegates to visit the St. Lawrence Power and Seaway Project at and above Cornwall, Ontario, power developments at Niagara Falls, and an atomic reactor at Shippingport, Pennsylvania. Other points of interest to be visited include hydroelectric developments on Quebec's Sagnenay, Peribonka and Bersimis Rivers, and at Shawinigan Falls on the St. Maurice.

National Delegates

Nations whose delegates are scheduled to present papers at the September meeting include Canada, Austria, Great Britain, Italy, Poland, Spain, Russia, the United States, Yugoslavia, Czechoslovakia, France, Switzerland, Germany, Brazil, Australia, India, Japan, Portugal, Uraguay, Roumania, Sweden, Belgium, Finland, Indonesia, Hungary, Trinidad and Tobago, Luxembourg, Bulgaria, Denmark and the United Arab Republic.

Canadian Contributions

Canadian delegates will present papers on nearly every aspect of the meeting.

On hydraulic energy, T. Ingledow, vice-president of British Columbia Electric Company will cover "Integration of Gas Turbines in Hydroelectric Systems"; T. D. Stanley, production superintendent at Calgary Power Company, the "Economics of Centralized Control of Electric Generating Plants"; C. G. Miller, of the Manitoba Hydro-Electric Board and H. Teekman of Ontario Hydro, the "Thermal-Hydraulic Generation Integration in Southern Manitoba and Northwestern Ontario".

Canadian papers on thermal energy have been prepared by C. L. O'Brian, assistant to the chairman of the Dominion Coal Board, on "Coal Production in Canada"; J. W. Flanagan, of Imperial Oil Limited, on "Petroleum in Canada"; Charles Buckel, chief gas engineer of British American Oil Company, on "Producing and Processing Sour Natural Gas in Western Canada as Typified by Pincher Creek Gas Field and Gas Plant"; Dr. W. B. Lewis, vice-president of Atomic Energy of Canada Limited, on the "Economics of Uranium and Thorium for the Generation of Electricity"; and by R. E. Barrett and Arvid Thunaes, both officials of Eldorado Mining and Refining Limited, on "Uranium Production in Canada".

Canadian spokesmen on electric transmission will include D. M. Farnham and J. R. Hango, both of Hydro-Quebec, whose paper deals with the "Economics of Transmission from Bersimis River Developments".

On transportation by rail, water, etc., R. W. Warren of Canadian National Railways will discuss "Economic Trends in Canadian Railway Transportation with Special Reference to the Transport of Fuel"; R. D. Walker of Trans-Canada Pipe Lines Limited and A. B. Jones of Inter-provincial Pipe Line Company the "Economic Trends in the Transportation of Fuel by Pipeline".

Several Canadian papers are to be presented on the utilization division of the Canadian Sectional Meeting. They include those by John Davis, director of research and planning for British Columbia Electric Company on "Economic Trends in the Utilization of Energy in Industry"; by L. M. Pidgeon, University of Toronto professor, on "Electrical Energy and the Production of Metals".

P. H. Southwell and C. G. E. Downing, both from the Ontario Agricultural College, will discuss "Utilization of Energy in Canadian Agriculture", while Paul E. Lamoureux, of Trans-Canada Air Lines, will cover "Utilization of Fuel in Aviation".

History of the Conference

The World Power Conference was founded in Great Britain thirty-four years ago, on the initiative of the late D. N. Dunlop. It was to form a link between the different branches of power and fuel technology, between experts of the countries of the world, and between scientists and engineers on the one hand and economists and administrators on the other.

The first World Power Conference opened in the Conference Hall of the British Empire Exhibition, Wembley, on June 30, 1924. From 43 nations more than 1,000 members had gathered to consider technical papers centring round the problems of making an inventory of the world's power and fuel resources and of using those resources to the greatest possible advantage.

Since then 14 plenary and sectional meetings, most of them in Europe, have been held. The most recent, in Belgrade last year, considered power as a factor in the development of underdeveloped countries.

Major General H. A. Young, M.E.I.C., Deputy Minister of Public Works, is Chairman of the Canadian Committee of the World Power Conference.

An international non-governmental agency, the Conference has consultative status in category "B" with the Economic and Social Council of the United Nations. It is also a member of the Union of International Engineering Organizations.

Its central office is located in London, and 52 member nations are represented through national committees.

Meeting Organization

Representatives of companies and other organizations operating in the associated fields of production, transportation and utilization of energy form the Canadian National Committee. The federal government itself, moreover, recognizing how important it is to develop Canada's power resources and how desirable that nations share the scientific knowledge and skills by which power may be produced most efficiently, gives strong support. It has its own representatives on the Committee, and contributes the annual fee to the central office in London.

More than two years of detailed planning have been necessary to prepare for the September meeting, which first originated during a meeting of the International Executive Council, in Paris in 1955. Only once before had the Conference been held in North America, and that was in Washington, in 1936. But at the Paris meeting, the Canadian Committee formerly extended an invitation to visit Canada. This was accepted.

The choice of Montreal as the conference site reflects several factors affecting the convenience of the delegates. For one thing, the city is a terminus for ships, trains and planes. Moreover, it has plenty of first-class hotel space. And since English and French were to be the two official languages for the meeting, it seemed fitting to stage the event in a bilingual city.

Canadian Officials

Major-General H. A. Young, Canada's Deputy Minister of Public Works, is chairman of the Canadian Committee, and a list of Canadians prominent in power and associated fields has been responsible for making arrangements for the event.

Hugh Crombie, vice-president of Dominion Engineering Works Limited, is general chairman of the various sub-committees involved in making arrangements for the Canadian meeting. General secretary is T. M. Patterson, director of the Water Resources Branch of Canada's Department of Northern Affairs and National Resources.

Chairmen of the sub-committees include: J. A. Fuller, president, Shawinigan Water & Power Co.; R. Latreille, commissioner, Quebec Hydro-Electric Commission; A. C. Abbott, vice-president, Shawinigan Water & Power Co.; R. L. Hearn, consulting engineer; B. C. Fairchild, managing director, Canadian Electrical Association; M. P. Murphy, executive vice-president, Northern Electric Co.; R. L. Dunsmore, president, Champlain Oil Products Ltd.; Alan Field, director, Canadian Government Travel Bureau; L. Austin Wright, general consultant, The Engineering Institute of Canada; A. W. Manby, general manager, The Hydro-Electric Power Commission of Ontario; and Louis O'Sullivan, commissioner, Quebec Hydro-Electric Commission.

Education for Tomorrow

R. S. Gustavson
President, Resources for the Future, Inc., Washington, D.C.

Address given at the Banquet during the 72nd Annual General and Professional Meeting of the Engineering Institute of Canada, Quebec City, May 1958

FREEDOM AND SCIENCE are two words that come with increasing frequency from the lips of men. Freedom has been concerned with political freedom, with the right of free speech, and the freedom to worship as one's conscience dictates. Within the last few decades, these two basic freedoms have been related to two other fundamental freedoms, namely, the freedom from want and the freedom from fear. The people of Asia and two hundred millions in Africa are either in their swaddling clothes with respect to freedom or are demanding its birth. These people are not only looking forward to a higher standard of living with freedom from want; they are demanding it. The new freedom is being sought by the underdeveloped countries at a time when the world is divided between two great ideologies. The ideology of a democracy and the ideology of totalitarian government. These underdeveloped countries are looking to science and technology to achieve this goal of freedom. The big question today is whether these underdeveloped countries will work out the answer to this fundamental question within the framework of democracy or within the framework of totalitarian government.

Standard of Living

The standard of living enjoyed by the United States and Canada today makes tremendous demands upon the resource base not only of their own countries but great demands upon resources of countries great distances from them.

The United States today, with approximately seven per cent of the world's population, is consuming about 50 per cent of the world's goods. In fact it is so rich that it can consume about two-thirds of the world's production of oil, leaving only one-third for all of the other countries. The very high consumption of the world's available resources by the United States will increasingly meet competition from many parts of the world where there is an insistent demand for a higher standard of living, which will not be denied. The United States has been thrust into the leadership of the world by two world wars. It is difficult to see the possibility of any other leader for a long period of time — perhaps several centuries. Basically this means that the United States has become on a world-wide scale our brother's keeper, or shall we say democracy's guardian. This means accepting the responsibility for helping the underdeveloped countries conquer their poverty and disease within the framework of democracy. Leadership is a very simple role to discern but an awful responsibility to live up to. We did not seek the position of world leadership but it is our destiny to fulfill it.

In the world of science, man's greatest achievement has been the realization that he lives in a consistent universe; that is, if he asks nature a question by way of experiment at two different times and the conditions of the experiment are the same, nature will give identical answers on both occasions. The path from the concept of a universe ruled by caprice to the concept of law is a long and difficult one. Gradually a body of knowledge which we now call science has been established. Professor Niels Bohr, distinguished atomic physicist of Denmark, has described this body of knowledge as resulting from "the finding of techniques that have enabled man to place limiting values on his preconceptions."

The important thing to notice in Professor Bohr's statement is that it is not the preconception which is most important in science but the techniques by which man can determine the limitations for his preconception. Let me illustrate.

If you would paint a portrait of Abraham Lincoln you must first develop within your own mind a conception of the painting. You decide whether you are painting the rail splitter, the Indian fighter, the weary war president. You examine paintings, photographs, and various pieces of art representing the great emancipator and then you start to work with brush and paint and canvas. But there is nothing in the painting process that tells you whether you are right or wrong and your success as a painter depends upon how closely the final product represents in the concrete the preconceptions that you started with.

Recent Achievements of Science

Let us review some of the recent achievements of science. The outstanding discovery in the realm of physics has been the conversion of matter into energy so beautifully described by the Einstein equation, namely, $E = M\ C^2$ where M is the mass of the matter destroyed and C is the velocity of light. The velocity of light is 186,000 miles per second and this number squared, is 35 billions. So even if the amount of matter destroyed is small the energy liberated is very large. The discovery of the conversion of matter into energy rests upon a half century of basic research. At the turn of the century, studies made in connection with the element radium, revealed that this element was giving off energy to its environment in the form of strong X-ray-like penetrating radiations called gamma rays; negative electrical particles called electrons and positively charged atoms of helium which are called alpha rays. These helium particles were thrown off from radium with a velocity of 10,000 miles per second and represented at the time of their discovery the greatest concentration of energy known to man. Comparison of the energy of the steam particle with the alpha particle reveals that the alpha particle contains approximately 400 million times as much energy as the steam particle. Rutherford bombarded the element nitrogen with this high energy alpha particle and found hydrogen atoms were formed as a result of the bombardment. This was one of the great fundamental discoveries of the past half century. In following up this kind of experiment it was found by Bothe and Becker in Germany, that when the element beryllium was bombarded in a similar fashion, a strong penetrating radiation was given off which was erroneously interpretated by the German workers as being a type of X ray. Chadwick in England corrected this impression by showing that the beryllium under bombardment with the alpha particle was giving off an electrically neutral particle of about the same mass as the hydrogen atom but with a velocity of approximately 10,000 miles per second. Workers then began to bombard the elements with this neutral particle. It was in the course of this kind of experimentation that it was discovered that when natural uranium is struck by the neutron, some of the uranium atoms go to pieces and elements of smaller atomic weight are found in the debris. Matter is destroyed and tremendous quantities of energy are liberated. This was the work of Enrico Fermi in Italy and Otto Hahn in Germany. On the basis of these experiments, atomic bombs have been built, two of which have destroyed Japanese cities, and high temperatures have been made possible which approach those of the sun. These experiments are also the basis of the great effort which is being made today to work out peaceful uses for this energy in the form of electrical power, space heating and many other uses which we could describe if the time were available.

Attempts are now being made to realize experimentally the reactions producing heat in the sun and stars. There, at temperatures of ten to twenty million degrees centigrade, atoms of hydrogen stripped of their electrons strike each other with such force that the nuclei combine to form helium. Experiments in Russia, the United Kingdom and the United States indicate some success in duplicating this process in the laboratory. So far the energy liberated is a very small fraction of the energy used, but there is every reason to believe we are witnessing the birth of a new age—that of man-made thermonuclear reactions, until now known only in the sun and stars.

Importance of Energy Supply

The standard of living enjoyed by any country is directly related to the amount of energy which is available to the people of that particular country to carry on its work. If you want to dramatize the differences in the standards of living between India and the United States, there is probably no better way to do it than to indicate that in India the per capita amount of energy available to do the work of the Indian people is about 6000 large calories per day. The per capita daily amount of energy available to the people of the United States is roughly estimated at 120,000 large calories per day. The advent of atomic power now brings about the possibility of almost unlimited power for all of the nations of the earth, and therefore the possibility of a higher standard of living for all the people of the world looms large today.

I say "possibility" because the establishment of an atomic energy program requires a large capital investment. Where can this capital be found? Not in the underdeveloped countries where 90 per cent of the people are engaged in elemental agriculture and capital growth takes place slowly. For this reason it is possible that the gap between the highly industrialized nations of Europe and North America and a country such as India will widen with time unless ways and means are found for increasing the capital from outside sources.

Biological Sciences

Some of the recent work of Professor Stanley of the University of California in connection with viruses has indicated tremendous advances in understanding the chemical structure of these very complex bodies. It is in this field of large molecules that we have every reason to believe that the key to the cancer problem will be found.

In the field of biology the area of genetics is opening up very rapidly insofar as basic understanding is concerned. The new tools of biochemistry and biophysics are giving us the opportunity to carry out work in this field undreamed of a few years ago. As a result, new varieties of barley, for example, have been developed by irradiating the plant which gives a higher yield, stronger straw, and greater resistance to disease. In the mustard plant changes have also been brought about genetically which have given very large increases in yield. This field is in its infancy. As a result of studies in the field of radiation genetics, science is now not only pointing to the possible results that may be of benefit to mankind coming through work in the field of radiation genetics, but is also setting up a very definite warning against what may happen if in the age of atomic power and atomic bombs we are not careful about powerful radiations altering some of the genetic characteristics of man himself.

Implications for Education

These examples of significant work that is going on in the physical and biological sciences today are typical of course of a great many that might be described if time permitted. What are the implications for education? Surely one thing that stands out is the fact that all of our sciences — physics, chemistry, biology — are becoming increasingly quantitative in character. As information becomes quantitative it becomes subject to mathematical analysis and to description in mathematical terms. Mathematics is the language of quantitative data. This means of course that in our schools for those who are going to go into technical work, mathematics becomes increasingly a necessity. Our public schools have done a remarkably fine job in the field of teaching reading, and it is obvious now that some very fundamental work must be done in the field of teaching arithmetic. I am not ignorant of the progress that has been made, but research must be intensified. Our social organization has been undergoing change. Numbers today for the youngster in the kindergarten and early primary years are related to television channels, radio wave lengths, telephone numbers, license numbers, house numbers, in all of which cases the number has no quantitative significance. The research that is taking place today at the University of Illinois, under a grant from the Carnegie Foundation, in the mathematical curriculum for the ninth, tenth, eleventh, and twelfth grades is indeed promising. But much more research work needs to be done in the early grades, especially I would say from the fifth grade to the ninth grade because it is here that the antagonisms and the distaste for mathematics seems to be born.

In the opinion of many qualified scientists, biology may well be the next field in which great progress will take place.

Traditionally the effective tools have been the microscope, with dyes as secondary tools. The emphasis has been on morphology and classification, and ecology. The underlying theory which has given guidance to research has been the theory of evolution. This gave a strong stimulus to the study of taxonomy, comparative anatomy and embryology.

The new fields are the detailed structure and chemical reactions which characterize the protoplasm of cells and tissues. The new tools are the electron microscope, the spectroscope, ultramicrotomy (cutting biological material into sections so thin as to permit its study with the electron microscope). The radioactive isotopes are also powerful tools for metabolic studies.

It would seem to me that serious consideration must be given to the high school and college curriculum in biology. It is important that the high school student who has talent in mathematics, physics and chemistry should be aware of the possibility of using these tools in exploring the field of biology.

The Stimulus of Curiosity

Basic research has as its objective to understand the world about us with no other objective than to know; it is the kind of research that grows out of pure curiosity. This kind of research has found its home very largely in Europe, but today this responsibility is increasingly falling on the United States. The recent tremendous advances that Russia has made in the development of technical skills and engineering has undoubtedly precipitated a crisis in the minds of many people. I do not share this anxiety. It does seem to me, however, that it can be a stimulus to increase the efforts that we can make and should make in this field. It has many implications for education. It means at the elementary level that curiosity must be fostered. It means that asking students to merely repeat experiments in cookbook fashion must be increasingly eliminated from our educational program. I think if once we begin to explore the possibilities of rewriting the textbooks and reorganizing the experiments we shall find great fun in this task.

It was my privilege to teach sixth grade students one afternoon a week for a period of three years. I never had more fun.

Let me just describe one situation that took place and I think you will see what I mean. One of these afternoons I took a Pyrex test tube, placed some ice in it and asked the youngsters what they thought would happen if I heated it in the flame of the Bunsen burner. Almost with one voice they said: "The tube will crack."

To their surprise they found that it didn't crack, the ice melted. We wrote an equation on the board in their own language: *Ice + heat = water.*

We then heated the water to the boiling point and noted the steam which was formed, and again we wrote an equation in their own language: *Water + heat = steam.*

We then took some paraffin wax and I asked the youngsters what they thought would happen if I heated the wax. From their experience of course with the burning candle they told me it would melt. We heated the wax, it did melt. We wrote the equation: *Wax + heat = watery wax.*

The question: "What will happen if we heat the liquid wax?" *The answer*: "It will form steam wax." We heated the wax, the wax did become "steam wax." I then placed some pieces of rolled sulfur in the tube and said: "What do you think will happen if we heat the sulfur?" *The answer*: "It will form watery sulfur." We heated the rolled sulfur, it became watery sulfur.

The question: "What do you think will happen if we heat the water sulfur?" *The answer*: "It will become steam sulfur." We heated the liquid sulfur and to their surprise it solidified. "Let's see that again", they said with one voice.

Now I am not holding myself up as a master teacher, I am merely trying to indicate what I mean by organizing experiments to stimulate curiosity.

I then asked one of the youngsters what he made of all of this. I shall never forget his answer. He spoke with a kind of a drawl. "Well," he said, "it seems to me what it means is that just because you know something about water or ice and wax is no sign you know anything about sulfur." What wisdom!

Balanced Education

Let us seek balance in our educational programs. One of our outstanding dangers is that we tend to go to extremes in times of crisis. Many of us can remember the strong forces to eliminate the teaching of foreign languages in our schools during and after World War I. Today we see the folly of this attitude. Today the success of Russian scientists in putting satellites into space is giving rise to strong forces to emphasize the physical sciences and mathematics. Up to a certain limit this is good. We need to periodically review our work but let us not forget the social sciences and the humanities. May I point out some examples from the work of a man who is working entirely in the realm of psychobiology, Professor Richter of the Johns Hopkins University. Professor Richter for many years has recognized the fact that rats are very sensitive to their well-being and seemed to be able to react in a way that cultivates their well-being. For example, if rats are given a choice of many different fluids to drink and among them various strengths of alcohol, the rat will not touch alcohol in greater concentration than 6 per cent. Or let me give you another example. If you remove the pancreas from a rat, that rat becomes diabetic. It becomes necessary to revise the diet from the normal diet for both rats and human beings to a modified diet that will conserve the strength of the diabetic. We have worked on this problem for decades. When you do this to the rat, if you give him an opportunity to balance his own diet by placing in front of him isolated proteins, fats, carbohydrates, mineral salts, and water, and vitamins, in the course of a few days he will arrive at a balance that is just as good as we human beings have been able to work out after decades of study. And so on.

Psychological Influences

Now I want to discuss a new field that is just opening up and which is very hard to describe. Let me attempt it by outlining some recent experiments. Professor Curt P. Richter, of Johns Hopkins Medical School, in a paper presented recently before a memorial seminar in honor of the late Professor Walter Cannon, begins his paper with the following statement:

> "'Voodoo Death'—that is the title of a paper published in 1942 by Walter Cannon. It contains many instances of mysterious, sudden, apparently psychogenic death, from all parts of the world. A Brazilian Indian condemned and sentenced by a so-called 'Medicine man,' is helpless against his own emotional response to this pronouncement—and dies within hours. In Africa a young Negro unknowingly eats the inviolably banned wild hen. On discovery of his 'crime' he trembles, is overcome by fear, and dies in 24 hours. In New Zealand a Maori woman eats fruit that she only later learns has come from a tabooed place. Her chief has been profaned. By noon of the next day she is dead. In Australia a witch doctor points a bone at a man. Believing that nothing can save him, the man rapidly sinks in spirits and dies.
>
> "Cannon made a thorough search of reports from many primitive societies before he convinced himself of the existence of voodoo deaths."

Professor Cannon then asked himself the question: "How can an ominous and persistent state of fear end the life of man?" Having accepted then the possibility of "Voodoo Death", Professor Richter proceeded to set up experiments trying to place limiting values on this preconception. His experiments in my opinion are fundamental. He found, for example, if he trapped rats, wild rats, in a sort of leather bag which provided ample air for their living purposes but kept them trapped, they struggled for awhile, then apparently gave up the struggle and died. Why did they die? Not for lack of air, not for lack of stored chemical energy in their muscles. What physiological and psychological processes were involved? If one repeats the experiment, only this time after the animal has made a struggle he is temporarily liberated, and then trapped again, this second time the struggle goes on to complete exhaustion, a much longer struggle than the initial one. The crux of the experiment apparently is that if the rat has reason to believe, by virtue of a single experience, that the situation is not hopeless, he makes a struggle far beyond what he would make and lives much longer than he would ordinarily do under the same conditions. The implications of this kind of study for the world in which we live which is one dominated by fear, must be obvious.

Science and technology lead to engineering and large-scale production with tremendous implications on our social organization. Eventually this calls for social judgments. No better illustration of this can be given than the question of radioactive fallout which is a difficult problem before the world today.

We recognize in radio and television marvelous instruments for the education of young and old. Not long ago I heard a fine interview with Mr. de Valera of the Irish Republic. Another time we were given an opportunity to review by way of television some of the life of Mahatma Gandhi. On the other hand, we also know the abuses which take place through the same medium of communication. We are led to believe that certain drugs will take care of us when we are ill, through the most false kind of presentation. These call for social judgments. Where will we develop these social judgments? In science? No. Science is not interested and cannot be interested in social judgments. These are value judgments. Where will you find a finer dramatization of the age-old problem of how to do justice without doing an injustice than in Shakespeare's Hamlet. What kind of foreign policy should we have? Perhaps we should listen to Immanuel Kant making his plea to act, to act, to act, so that our actions may become the standards of conduct. When we are being placed as educators under pressures to teach the law of the thing in terms of the physical sciences to the neglect of the social sciences and the humanities, shall we listen to Emerson when he warned us:

There are two laws discrete,
Not reconciled, —
Law for man, and law for thing;
The last builds town and fleet,
But it runs wild,
And doth the man unking.

When we are under pressure by the crowd to think and work with the crowd rather than to maintain our independence in our thinking, should we listen to Emerson:

> "It is easy in the midst of the crowd to be true to the crowd's opinion; it is easy in the solitude to be true to one's own, but the great man is he who in the midst of a crowd keeps the independence of the solitude."

What to do about it? It is obvious that technology will play an ever-increasing part in our culture. The teaching profession will be given heavy responsibilities for preparing our young people to play their part in this world of change. Young people having talents in the field of mathematics must be given the opportunity to grow in this field. They must also be given the opportunity to become aware of the increasing importance of mathematics to physical and biological science. At the same time the door must not be closed to young people having a "blind spot" for mathematics. History shows many examples of great creative research work in the field of the physical sciences by those who are not highly trained in the field of mathematics. There is much research to be carried on in fields that are not yet quantitative as I have tried to show.

For the teacher it means better preparation and this means the opportunity for advanced study. Our universities must re-examine their requirements for the master's degree for teachers who have only two years' preparation in given subject matter fields. A comradeship which has been broken during the past decade or so, that existed between the university teacher and the high school teacher must be re-established. For the citizen it means that our teachers must be paid yearly salaries commensurate with the responsibilities that they carry. The prestige of the teacher must be such that the profession will attract young people from all economic sectors of our society. Perhaps in concluding I should paraphrase George Eliot by saying: "Let us not be pessimists, because educators have done a magnificent job in educating our young people to work within the framework of democracy: let us not be optimists, because optimism can dull our sense of what is critical and what is significant in a changing world and lead us into a chronic state of mediocrity. Let us rather be ameliorists, that is, if things in education are not as they should be all of us will lend our hands, our heads, and our hearts to making them so."

The prestige of the teacher must be such that the profession will attract young people from all economic sectors of our society.

DISCUSSION

of Technical Papers and Other Articles

ECONOMICS OF PUMPED STORAGE

C. Jaeger, *The English Electric Company Limited, England*

The Engineering Journal, 1958, June, p. 67

(This discussion refers to the full paper, as presented at the Annual Meeting and published in Water Power *(London) June, July, Aug. 1958)*

F. L. Lawton,* M.E.I.C.

The Institute is particularly fortunate in having Dr. Jaeger's most realistic treatment of a subject which is usually wrapped in a mass of complexities — more bluntly, a long series of "ifs", "ands" and "buts". This realistic treatment has long been needed.

The author's down-to-earth treatment arises only partly, although very significantly it is suggested, from the question he posed, after referring to the use of computing machines, when he said "The 'answer' given by such a calculating machine depends on which parameters have been fed into the computor and how they have been fed into it. Is not some simple basic thinking possible relying on more elementary mathematical analysis"?

The other element, complementary to the foregoing, is that basic thinking which is so characteristic of European engineering practice, arising from the relatively low cost of engineering man-hours and the relatively high cost of materials. The reverse is, of course, true in North America.

Computing machines can relieve the burden of tedious computations but cannot do any thinking. Reliance on computers will, no doubt, constitute a hidden potential hazard which engineers will need to guard against carefully in the future.

Although largely based on nuclear generation in conjunction with pumped storage, the author's treatment is equally relevant to thermal and hydro generation.

It may be of interest to note that pumped storage appears to be receiving close attention for the hydro-thermal Japanese power systems where normal storage reservoirs are not easily developed on account of geological and land-use problems.

With reference to Table II the terminology is a bit obscure. It is presumed the author is referring to two circuits of overhead transmission in columns two and three, and to two circuits of overhead transmission in column four, the only difference in column four being that multiple or bundle conductors are used.

*(1) Chief Engineer, Power Department, Aluminium Laboratories Limited, Montreal.

I. W. McCaig,† M.E.I.C.

Dr. Jaeger's analytical study of the economics of pump storage has, I am sure, got many of us trying to remember these complicated integrals which we had in our mathematics course at school. Dr. Jaeger manipulates them with great skill and brings out several important points which would not have been obvious without his mathematical analysis. He first shows how pump storage can aid the economic production of energy by nuclear and thermal stations and then indicates how, even in a system where all the energy is generated by hydro-electric developments, pump storage can be utilized for storing excess energy from run-of-river plants and for increasing the capacity of long transmission lines and cables.

Before coming to Canada, I had the pleasure of being associated with some of the economic studies for the Sron Mor pump storage unit, the first in Britain, which formed part of the larger Shira hydro-electric scheme. At that time, it was difficult, with the assumed difference between on peak and off peak power costs, to justify the installation of a pump unit in this mixed hydro-electric and pumped storage scheme. However, it is interesting to note, in retrospect, that even before the Sron Mor plant was completed plans had gone ahead and construction had started in Britain on the 300,000-kilowatt Ffestiniog pump storage scheme.

With hydro-electric sites in Canada becoming scarcer and further from load centres, the mixed storage scheme now being completed at Niagara Falls may well be the forerunner of a number of pump storage schemes designed to cater for peak loads at industrial centres.

†Hydraulic Engineer, H. G. Acres & Company Limited, Niagara Falls, Ont.

T. J. Hobson,§ M.E.I.C.

With reference to part III of the paper, sections 3 and 4, all cases taken assume that $t_1=t_2$.

This means that over the entire period of any cycle of operations, the pumped storage station is in use as either a pump or a generator.

For the simplified and theoretical condition that the base load station operates with unity load factor, this is necessarily true. However, for the more general case in which $\theta_B<1$, it is not necessary although it does give the most efficient operating results.

Does the author think that this condition can ever be achieved in actual practice?

Would the author care to discuss the effects on his calculations of a substantial period of time during which the pumped storage station is neither pumping nor generating, such as might occur on a weekly cycle with nearly all the pumping done over the weekend, and the generating limited to a few hours daily?

W. G. Lockett,‡ M.E.I.C.

Among the most important factors which have to be considered in the study of pumped storage projects are the increase of the load and the

§British Newfoundland Corporation Ltd., Montreal.

‡Niagara Falls, Ont.

possible variation of load factor which will take place during the life of the scheme. As the author has demonstrated, it is possible, for a given load-duration curve, to arrive at optimum relative values for the installed generating capacity, pumping capacity, and energy storage. However, when absolute values for these quantities are considered, it is clear that the figures will "fit" the load curve only once as it increases with time.

Now in practice, while it will be possible to increase the generating and pumping capacity of a scheme by the progressive extension of the power station (unit by unit or stage by stage), it will not usually be practical to increase the storage capacity in a similar manner. It is suggested that the tendency will be to provide in the initial stage of a development the maximum storage capacity consistent with site conditions. This will allow for flexibility of operation and provide to some extent for errors in the long-term prediction of the energy demand and load factor. In effect, over the years the pumped storage scheme would probably be called upon to operate at widely varying load factors. In the study of such problems the author's equations should be particularly useful, as they would enable a multiplicity of different conditions to be studied without much difficulty.

It is tempting to speculate on the position pumped storage is likely to occupy in Eastern Canada, where there is a forseeable limit to the development of conventional hydro resources. The author hints at this problem when he states in section IV of the paper: "Where gravity water storage and pumped storage are being compared, marginal prices for a pumped storage will have to be compared with the cost of an enlarged hydro-power station." We have to assume that the base load will be taken by thermal and nuclear power plant of ever increasing capacity. Hydro stations, existing and projected, will tend to move progressively up the load curve, where it will be found that, while their energy output may for a time be adequate, there will be a constant demand for more and more kilowatts. Later on the energy output of the peak load hydro schemes will not be sufficient and pumped storage on a large scale will be required. The important point is that all this will occur during the useful life of schemes at present on the drawing board or in the report stage. Would the author agree with the conclusion that from now on every hydro project with adequate pondage and a relatively short development should be regarded as a potential peak load scheme? This would entail careful consideration of future additional intake works, tunnels, and the extension of the power station itself. The possibility of having to provide a tail pond for a later pumping installation would also have to be borne in mind.

In conclusion, I should like to ask the author for his comments on the subject of differential tariffs. Suppose C_1 represents the capital required to subsidize a vigorous policy of differential tariffs, and C_2 the cost of the additional pumped storage scheme necessary to arrive at a certain overall operating characteristic. Is it not possible that $C_1 + C_2$ will be less than the cost of the larger pumped storage scheme required to produce by itself the same characteristic?

The Author

The author is much indebted to Mr. F. L. Lawton for the backing he gives to his efforts to analyse the complexities of the economics of pumped storage. His interpretation of Table II is correct. The problem of high voltage long distance transmission in connection with pumped storage becomes so important that the author has started an enquiry in order to get more reliable figures and facts.

The remarks by Mr. I. W. McCaig concerning the economics of the Sron Mor pump storage unit are pertinent. There is no better proof that pumped storage is economical than the efforts made by large power distributors all over the world to develop more pumped storage capacity as soon as they have started their first scheme.

Mr. T. J. Hobson raises an important question which has to be answered in two parts. He notes that Figures 17 and 18 are drawn assuming the pumped storage station to be always in use as either a pump or a generator. Can this condition ever be achieved in actual practice and how does it affect the author's calculations if this is not the case?

(a) Fig. 20 and the equation

$$\Delta N = \left(\frac{dN}{dt}\right)_{t_1} . \Delta t$$

solve the problem for a "time lag Δ t", and Fig. 19, 20, 21 give a method for estimating the loss in capacity ΔN and energy ΔE caused by the time lag. If this time lag is long, a direct calculation will replace the simplified equation for ΔN.

(b) It is most probable that, when a pumped storage station is equipped with reversible pump-turbines with variable pitch, full use of their versatility will be made and the daily load diagram will tend to reduce the time lag to a minimum.

If the pumps have no movable blades, then they will always absorb a constant power and cannot be adapted to the variations of the demand. Longer time gaps will be inevitable, which means loss of power energy and revenue, and more work for those other stations which inevitably will have to be equipped with variable pitch runners for correctly balancing power production and demand.

(c) Mixed pumped storage stations superimposed on conventional hydropower stations could work more efficiently for longer hours than pure pumped storage stations, which usually are designed for short hours and high installed capacity.

Mr. W. G. Lockett's first remark raises one of the most important points of the discussion and the author's answer to it is: "Definitely yes!

Every hydro project with adequate pondage and a relatively short development should be regarded as a potential peak load scheme. This would entail careful consideration of future additional intake works, tunnels, and the extension of the power station itself. The possibility of having to provide a tail pond for a later pumping installation would also have to be borne in mind."

In a previous article (*Water Power*, February/March, 1957) the author has discussed some implications of this change of attitude with regard to high-head or medium-head schemes. Another typical example concerning the extension of schemes with heads of 200 to 400 feet was shown during the presentation of the paper in Quebec, where it was also pointed out that the availability of a tail pond or downstream reservoir was one of the main points to be investigated.

A look at diagram Fig. 27 representing a yearly power duration curve may illustrate some further points directly connected with Mr. Lockett's question. Suppose a low-head power plant with little (daily) storage has been developed for a power N_w, corresponding to the discharge not available on the river for t_0^* days and available for $(365—t_0^*)$ days. If this power is increased by ΔN_w (measured on the duration curve and supposed to be available all the day long), this additional power would be available only $(365—t_0^*)$ days (possibly 120-170 days) and produce about ΔN_w

$(365—t_0^*)$ x 24 kwh. of intermittent base load energy of little value.

Suppose now that pump/turbines are installed on the same existing plant with an installed capacity $\Delta N'$. If θ_g is the "generating load factor" of this plant we can write that $\Delta N' = \frac{\Delta N}{\theta_g}$ (θ_g may be 3-5 hours a day). This additional installed capacity could work during $(365—t_0^*)$ days as peak load plant, using a limited daily reservoir capacity. During t_0^* days a year the plant would work as a day and night generating and pumping station. Instead of a capacity ΔN available only over a short period of the year for producing intermittent base load, a substantially larger capacity $\Delta N'$ would be available all the year round for peak load.

This leads to Mr. Lockett's second question. Differential tariffs are used directly or in a more concealed manner by most producers of electrical energy. They are favoured by energy producers using systems mainly fed by water power (as are some such systems on the continent of Europe) rather than by producers of thermal energy. They will most probably become still more favoured in the future and industries will have to adapt themselves—to some extent—to differential tariffs. Forecasts are difficult to make, as new inventions may reverse the trend (for instance, in some large towns, air conditioning has already shifted the peak load period).

Mr. Lockett foresees that hydro stations will tend to move progressively up the load curve. This is probably true in general. But there are also some potential hydro power sources—still available in Canada in the Far North (east and west) — which probably will be developed as base load because of the long transmission lines.

The general analytical approach to problems of power production introduced by the author can be further developed. A very promising extension of the method considers "differential" prices and costs as caused by changes in the load N, the efficiencies η, the load factor θ and so on, and a comparison of alternative solutions.

FINAL REMARKS

A final remark concerns the author's firm belief that more run-of-river stations, when built in continuous series on the same river, should be equipped with reversible pump-turbines. A modern run-of-river station will usually be designed for a discharge slightly in excess of the yearly average flow (usually the flow occurring (365—250)=115 days on the duration curve or something like this). During the dry season the station can neither face the demand for energy nor for capacity.

Now suppose some of the runners or even some additional runners were reversible pump-turbines. Then, whatever the duration and severity of the dry period, capacity would be available for peak load; this is a definite improvement on a station designed merely as a run-of-river station, unable to guarantee any peak load.

During the flood period, the additional reversible runners would be used as turbines, with no need for pumping.

In many cases this additional peak capacity will be reasonably cheap compared with alternative solutions. The technique of "over-equipped" run-of-river stations may be a sound policy if reversible runners are used and a reasonable storage capacity is available upstream and downstream of the station.

THE INTERNATIONAL GEOPHYSICAL YEAR

D. C. Rose, M.E.I.C. *National Research Council, Ottawa, Ont.*

The Engineering Journal, 1958, August, p. 45

D. A. G. Waldock,* M.E.I.C.

Dr. Rose is to be complimented on his comprehensive and interesting paper. I am sure that it must be a source of considerable pride to all of us and a pleasant surprise to many of us to learn what a relatively large and varied contribution Canada is making to the International Geophysical year. Since we are privileged to possess a large share of the earth's surface extending from one pole more than halfway to the equator, it surely behoves us to take an appreciable interest in the study of its physics.

In listening to Dr. Rose's paper, two questions arose in my mind. When one hears about the various phases of the International Geophysical Year program and the enormous amount of valuable scientific information that is being gathered over a wide variety of disciplines, when one thinks of the numerous applications to which this information will be put, when one realises the extent of the international co-operation and good-will which this program is stimulating, one cannot help but wonder as the year moves along — what happens at the end of I.G.Y.? Does it just peter out to be revived again in another 25 years' time? Is consideration being given to prolonging these international studies on a continuing but less intense basis? Perhaps Dr. Rose could enlighten us on what is likely to happen at the end of this year. With the rapidly increasing strides of modern technology and the more widely awakened interest in scientific research throughout the world, surely there must be a strong drive to perpetuate the international programs that have been launched as a result of I.G.Y.

The second point that occurs to me concerns the reduction, correlation and interpretation of the vast amount of data that is being collected during I.G.Y. We have been given some idea of the amount of effort that is being devoted to collecting this data, but this must be only a fraction of the effort that is going to be required to assimilate it. Perhaps our capacity to digest this data will itself limit the extent of future international geophysical programs. Would Dr. Rose care to comment on the arrangements for handling all the data that will be forthcoming from the various I.G.Y. programs?

*Chief Superintendent, Canadian Armament Research & Development Establishment, Quebec, Que.

The Author

In regard to the first question about the continuation of measurements after the end of 1958, a great deal of thought is being put on what should be done. Proposals for continuing observations in some disciplines have already been circulated. Considerable care is necessary in agreeing to these because the ultimate desired objective is the use of the data to learn more about the nature of the earth and its surroundings. We do not want the analysis and digestion of data hampered by enthusiasm to continue taking measurements that will only be put on the shelf. During the I.G.Y. period so much time is being given by scientists in just getting data that it would be quite impractical to continue at the present scale. On the other hand, without doubt, some of the observations will be continued, for instance, some of the stations on Antarctica. Decisions in this regard will be discussed at coming International meetings but probably the various scientific groups will decide themselves how they can best meet the research objective.

Brigadier Waldock is quite right in

(continued on page 146)

ABSTRACTS

MONORAIL TRANSPORTATION

The Consulting Engineer, March, 1958.

A PROPOSED MONORAIL between the centre of London and London Airport is under consideration by the Ministry of Transport and Civil Aviation. The cost per mile is estimated at some £280,000 for a double track system complete with rolling equipment. Over 3 million passengers passed through London Airport in 1956. By 1970 it is estimated during busy periods the airport may be handling 4,700 passengers per hour with an occasional peak of 6,000/hr.

The London to Heath Row airrail would consist of highspeed pneumatic-tired coaches running on elevated concrete beams. Coaches would also be equipped with road wheels for handling at the terminal direct to the air-craft. Time of journey would be about 15 minutes. The cost will be much less than that of any other of the various systems so far suggested.

NO ABSTRACTING AGENCY NECESSARY

Chemical & Engineering News, May 19, 1958.

PROPOSALS TO SET UP a monster central government agency in the U.S. for abstracting and indexing scientific literature seem about dead. It would be extremely costly, unwieldy and impractical. Abstracting and indexing should remain in the hands of scientific societies now sponsoring it, according to E. J. Crane, Director of Chemical Extracts Service. The government role should be to catalyze the work now going on.

OPENING THE RUSSIAN ARCTIC

Canadian Aviation, May 1958, p. 30.

TODAY THE U.S.S.R. ranks with leaders in the successful use of aircraft under arctic conditions. Russia's reputation as a leading arctic air power rests mainly on use of aircraft for solving scientific and economic problems of the soviet arctic. Aviaartica, basically a cargo airline, is probably the world's largest. Emphasis on ice concentration data is explained by the Soviet Union's desire to increase the length of the navigational year by making it possible for vessels to operate even through severe ice conditions.

Development of airport equipment to meet Arctic flying conditions is also reported. Considerable success has been achieved with new methods of speed braking on touchdown. Ice free runways are established by electric circuits underneath long concrete runways at main arctic bases of Russia's strategic air command. The chances are Russia will exert even greater effort in the next quarter century to establish itself as the world leader in arctic aviation.

PHILIPPINES ENGINEERING

Engineering Times, v. 1 n. 1, April 1958

THE FIRST ISSUE of *Engineering Times* (Manila) appeared in April 1958. This newcomer to the field of engineering publications aims to serve as an intermediary between the growing Philippine engineering profession and the general public. There is considerable engineering development in the Philippines, and one of the most controversial subjects is the Marikina Multi-Purpose Project, which is dealt with in an editorial and the first of a series of articles.

The project was authorized to regulate and store the flow of the Marikina River; to use the water for irrigation of agricultural lands and to increase the industrial and municipal water supply of Manila and its environs; and to generate and distribute electrical power. Initial plans for plant capacity of 180,000 kw. with a first stage of 120,000 kw. were amended to 90,000 kw. and 60,000 kw., respectively, and the distribution of costs between the various parts of the project was revised to make the scheme generally more attractive.

Because of difficulty in obtaining financial support from the United States, the project co-ordinating committee turned to Japanese reparations as a means of getting necessary finances, and a contract was concluded in September 1957 with an organization in Japan covering engineering consulting services, under the reparations agreement between the two countries.

Although these efforts to get the project started have generally been well received, strong protests against the employment of Japanese engineers have been made, particularly by the president and members of the board of directors of the Philippine Association of Civil Engineers. The chairman of the project committee has defended the legality and practicability of the Japanese contract, and pointed out that the proposed concrete arch type dam is new to indigenous engineering and justifies the use of foreign consultants.

Tunnelling Saskatoon's 14th Street Storm Sewer

(continued from page 77)

is from 3000 to 5000 dollars, depending on the availability of materials and machine shop service. The cost certainly is not excessive when distributed over a thousand feet or so of tunnel.

Acknowledgements

Mr. C. Fisher, of Armco Metal and Drainage Products Ltd., provided much helpful advice and assistance during tunnelling operations. The writers would also like to express appreciation to Mr. W. A. Friebel, City Engineer, Saskatoon and Mr. R. Peterson, Chief Soil Mechanics Engineer, P.F.R.A., for their help and encouragement in preparing this paper.

References

1. Glossop, Rudolph, Classification of Geotechnical Processes; Geotechnique, June 1950, vol. II, no. 1, p. 9.
2. Casagrande, Leo, Electrical Stabilization in Earthwork and Foundation Engineering; Proc. of Conference on Soil Stabilization, M.I.T., June 1952, p. 84.
3. Hardy, R.M., Research Underway in Department of Civil Engineering, University of Alberta, Proc. of 7th Canadian Soil Mechanics Conference, N.R.C. Technical Memorandum No. 33, Dec. 1953, p. 24.
4. Tchebotarioff, Gregory P., Soil Mechanics, Foundations and Earth Structures, McGraw Hill, 1951, p. 423.

INTERNATIONAL NEWS

Development of Semiconductors in the U.S.S.R.

Academician A. F. Joffe

The modern history of semiconductors dates from Grondale's discovery of copper protoxide rectifiers of alternating current in 1927. The significance of this original physical phenomenon was correctly understood by Soviet physicists from the beginning. Up till World War II the study of semiconductors and their practical application proceeded at a rapid pace. Already its significance was understood not only for the transformation of alternating into continuous current but also for the conversion of luminous and thermal energy into electric current with the help of photoelectric cells and thermocouples. The war temporarily diverted Soviet physicists from the work on this problem.

Later semiconductors passed from electrotechnics to radiotechnics where they served to replace vacuum tubes. But their significance was not confined to this. They have promoted the rapid progress of automation, signalization and remote control; they protect high-voltage transmission lines against lightning discharges, save electric current in daylight lamps, and ensure the efficient work of the scores of thousands of elements in electronic computing machines. In radio apparatuses semiconductors substitute not only vacuum lamps but also other parts, reduce them to fractions of their original size and cut the consumption of electric energy.

Semiconductors have called forth new measuring techniques, new apparatuses and new potentialities. Soviet physicists are making good use of these potentialities in industry, agriculture and science.

Agricultural Applications

A series of semiconductor apparatuses has been developed for agricultural purposes to measure the temperature of the soil, the air and the plant itself, to determine the direction and intensity of light, and many other things. With their help it is possible to observe from one point all that takes place on a field.

Here is an example. An apparatus containing microscopic grains of a semiconductor makes it possible to follow the temperature and moisture at any point of a leaf or of the nearest layer of air. This led to the discovery of hitherto unknown physiological phenomena in the mechanism of evaporation and in the reactions of plants to light and warmth similar to the conditioned reflexes of animals and to other external influences.

Power Engineering

Another trend in the application of semiconductors is connected with the problems of power engineering. Soviet semiconductor thermocouples transform thermal energy into electric current with a heat efficiency which, although small as such, is neverthless sufficient for many practical purposes. For instance, the heat from the glass of a kerosene lamp supplies enough electric current to feed a large radio set, while with the help of a kerosene burner thermocouples can operate a small radio station. These apparatuses are demonstrated in the Soviet pavilion at the 1958 International Exhibition, in Brussels.

Thermocouples can produce electric current if there is a temperature difference in them. But they can be used in the reversed order: by passing electric current through them a drop in temperature may be obtained and the heat will pass from one side of the thermocouple to the other. In contrast to ordinary heating where warmth is carried from a warm medium to a colder one here a part of the heat can be carried from a cold source to a hotter one. Thus, in heating premises with electric current, with the application of thermocouples the building will receive only a part of the heat from the current, the rest will be transmitted by the thermocouple from the water supply or the outer air. In this case only 1/2-1/3 of the energy consumed by an ordinary electric stove will be spent.

Thermocouples are also used for producing cold. A home refrigerator will be demonstrated at the Exhibition which works without a compressor, ammonia or freon. A trap for vacuum pumps will be also exhibited. This trap, cooled by thermocouples, freezes oil or mercury vapours which under ordinary conditions decrease the vacuum when these liquids are used for pumping out air.

It was impossible to observe many fine physical phenomena due to the heat movement of molecules which interfere with the work of an apparatus under room temperatures. The thermocouple reduces the temperature in an apparatus by 50-60°C. and thus makes it possible to improve its work considerably (sometimes a hundred-fold).

Since the thermocouple, depending upon the direction of the electric current, either heats or cools, it can therefore keep the temperature of a medium at a constant level. The semiconductor thermostat demonstrated in the USSR Pavilion at the Brussels Exhibition markedly improves the quality of many radiotechnical apparatuses and other devices.

Soviet physicists gained all these practical results because they are keenly interested in the theory of semiconductors and strive to understand and study their properties. The development of the theory of semiconductors advanced simultaneously with the elaboration of the means of applying them in radio communications, industry, agriculture and transport.

Research

Many research institutes of the Academy of Sciences and the colleges are engaged in the theoretical study of semiconductors. Scores of industrial institutes conduct work on the application of semiconductors in radiotechnics, and these devices are already produced by a number of plants. Much literature has been published on the theory and practice of semiconductors.

In the U.S.S.R. many-sided work is being conducted with semiconductors. Not only the electric but also the thermal, mechanic, chemical, optical, and magnetic properties of semiconductors are studied. Semiconductors are used not only in radiotechnics and electrotechnics but also in power engineering, refrigeration, chemical catalysis, for different types of measurements, in agriculture, automation, illumination and signalization. The more widely they are applied the more promising is their future. Ever new possibilities present themselves and we are gaining deeper knowledge of the processes that occur in semiconductors.

UNITED KINGDOM

Giant Turbo-Generator

Believed to be the world's largest turbo-generator, a plant to be built in Newcastle-upon-Tyne, England, for the Central Electricity Generating Board, will be of 550 Mw. capacity. The manufacturers are C. A. Parsons and Company Ltd.

The plant will be a cross compound unit of two lines arranged in line ahead. Each line will have four turbines driving a 275 Mw. hydrogen and liquid-cooled generator. All eight turbines will be of the double flow type.

A single row velocity wheel will be used in the initial stage of both the high-pressure and the first intermediate-pressure turbines — each of these of double shell design; the rest of the blading is the reaction type.

The machine will operate with steam at an initial stop-valves pressure of 2,300 p.s.i. and a temperature of 1,050°F. Steam will be led to the turbine through two chests arranged one on each side of the high-pressure cylinder.

TRACKLESS CROSS-COUNTRY TRAIN. Most recent development in "rubber-tired trains" is this 52-wheel unit, of which a model has been built and operated to prove the advance design. Produced by R. G. LeTourneau, Inc., Longview, Texas, the train is intended for possible use of nuclear energy instead of conventional engines. The train features drive by electric motors to each of the 52 wheels and a unique steering arrangement which ensures that the last car of the train will follow in the tracks of the first, regardless of the number of cars. The train can thus be manoeuvred on a winding path through obstacles and can be reversed to travel with equal speed in either direction. The length of the train is about 450 feet, and the tires are 10 feet high by 4 feet wide. Gearing of the available 2000-odd horsepower will depend on operating conditions, but a probable compromise speed will be about 20 miles per hour.

Owing to the reheat system's large storage capacity, steam must be stopped from flowing into the turbine when sudden loss of load occurs: intercept and reheat emergency stop valves will therefore be incorporated in the reheat system. Valves which simultaneously release the steam to the atmosphere are an additional safeguard.

The turbine will have two governors — the main speed control governor, driven from the high-pressure turbine shaft, and an auxiliary governor driven from the first intermediate-pressure turbine shaft. There will be one governor mounted on a cross shaft driven through a worm and wheel on each line of turbines.

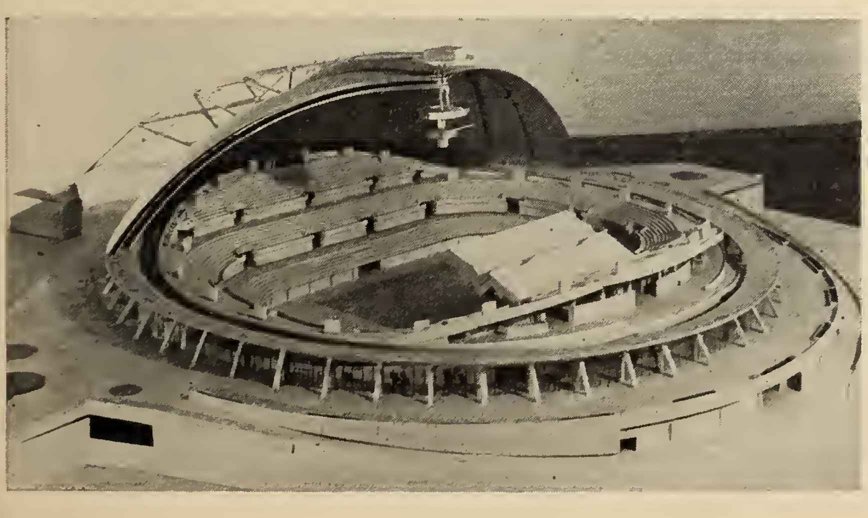
Steam can be extracted from the turbine at seven pressure points to heat the condensate returning to the boiler to a temperature of 486°F.

Motor-driven rolling gears will ensure uniform heating and cooling of the four turbine spindles and generator rotor on each line, when starting up or shutting down the machine, to avoid distortion due to unequal temperature distribution.

Steam from the turbine's eight exhausts will be dealt with by four condensers with a total cooling surface of 330,000 square feet. The generators will operate at 18,000 volts.

The rotors are to be of the direct gas-cooled type operating in hydrogen at a pressure of 45 pounds per square inch. Each stator will have a direct-cooled winding, using demineralized water as the cooling medium circulating through the conductors which are built up of hollow rectangular copper tubes.

MOVABLE DOME FOR PITTSBURGH CIVIC ARENA. The $20 million Pittsburgh Civic Arena is to have a retractable stainless steel dome roof, 415 feet in diameter. Six movable sections, three on each side, will roll over two fixed sections to open the arena to the sky. Structural steel for the dome will cost some $4 million, and a further $890,000 will be required for the mechanical seals and the stainless steel covering, which will be 20 and 22 gauge type 302 18/8 steel in a special dull finish. *(Stainless Steel News Bureau).*



Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

Construction Resumed on NPD

Construction has been resumed on NPD (Nuclear Power Demonstration), Canada's first atomic power station located close to Rolphton, Ontario and near Ontario Hydro's Des Joachims generating station on the Ottawa River, about 150 miles northwest of Ottawa.

The plant will produce 80,000 kilowatts of heat that will be used to generate 20,000 kilowatts of electricity, which will be fed into Ontario Hydro's power distribution system when NPD goes into operation in 1961. Atomic Energy of Canada Limited, Canadian General Electric Co. Ltd., and the Hydro Electric Power Commission of Ontario are collaborating on the construction of this project, undertaken in 1955.

The NPD station will not produce power at a cost competitive with that produced by coal-burning power plants. It will serve as a pilot plant for stations with outputs of 150,000 to 300,000 kilowatts of electricity. A.E.C.L. recently set up a Nuclear Power Plant Division in Toronto to produce a preliminary design for a 300,000-kilowatt atomic power station known as CANDU (Canadian Deuterium Uranium Reactor).

Work on the NPD site was stopped last year to allow important technological advances to be incorporated in the design of the station's reactor. The basic system pioneered at Chalk River — the use of natural uranium for fuel and heavy water for moderator — has not been altered in the redesign of the station, but a different type of vessel to contain the fuel and a new method of charging and discharging the fuel are to be used.

The original NPD reactor was to have a vertical steel pressure tank to contain the uranium rods and the heavy water moderator. The core of the new reactor will be a barrel-shaped, horizontal, aluminum tank about 13 feet long and about 15 feet across its greatest diameter. Through this tank run 132 aluminum tubes into which are inserted zirconium alloy pressure tubes that contain the fuel rods and the heavy water "coolant". The latter flows over the fuel rods, becomes heated, then travels to a heat exchanger or boiler where the heat is transferred to ordinary water to make steam. The steam is fed into a conventional steam turbine that drives an electricity generator. The heavy water is recirculated through the reactor to carry more heat to the heat exchanger.

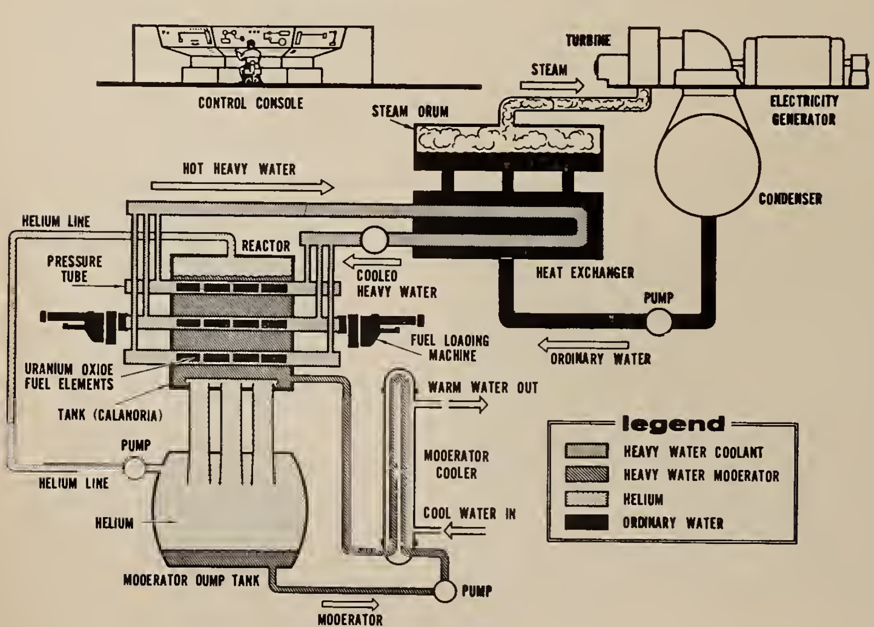
The other major design change involves the method of inserting new fuel rods and removing used rods. In the original design, the rods were to be inserted and removed from the top of the reactor. In the new fuelling system there will be a remotely-operated fuelling machine at each end of the reactor vessel, thus permitting the loading and unloading of fuel rods from both ends. This arrangement will give a more even distribution of fresh and partially used fuel throughout the reactor and permit the most efficient use of the uranium. The fuelling operation will be carried out while the reactor is under full power.

Canadian Exhibit at Geneva

A model of the NPD will be featured at Canada's exhibit at the Second United Nations International Conference on the Peaceful Uses of Atomic Energy, Geneva, September 1 to 13, 1958.

Canada's exhibit covers the full range of atomic energy developments. Included are fifteen models of atomic power reactors, cancer treatment machines, a uranium mine mill, the Port Hope Refinery of Eldorado Mining and Refining Limited, the research and production reactors at Chalk River, and a beta ray spectrometer.

Schematic diagram of the NPD plant



Campus Plan, University of Toronto

The Faculty of Applied Science and Engineering, University of Toronto

A Report on Growth in the Engineering Faculties in Canada

Eighth article of a series

The principal recent development related to new engineering courses or additional teaching facilities in the Faculty of Applied Science and Engineering is the procurement of a sub-critical reactor, primarily for graduate work. This installation was made during the early part of the year, but the reactor was officially inaugurated on June 19 by Premier Frost.

Though incapable of initiating a chain-reaction, the new reactor is otherwise similar to operating reactors. In addition, special electronic equipment is provided so that students can see actual operating conditions "simulated" and face problems that might arise in working with a full-scale reactor.

The new project marks the first entry of the Faculty of Applied Science and Engineering into the nuclear physics field, while the Department of Physics has already launched a concurrent program in nuclear physics.

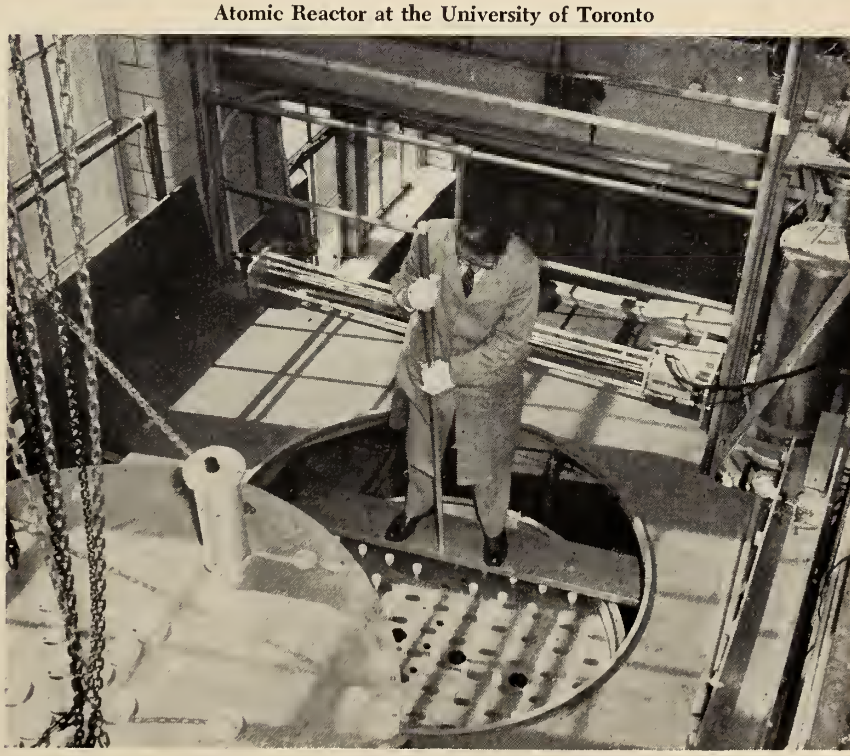
The whole equipment cost $439,000, with heavy water accounting for $200,000 of this sum. In addition, Eldorado Mining and Refining Limited have supplied on loan three tons of uranium worth $100,000, and a radium-beryllium neutron source was obtained from the Commercial Products Division of Atomic Energy of Canada Limited.

It was built by Canadair Limited and installed in the chemical engineering laboratory in the Wallberg Building, occupying two floors. This reactor is of the natural uranium, heavy water type, since it has so far been Canada's policy to build such reactors. It consists essentially of a cadmium-clad stainless steel tank five feet in diameter and six feet high, containing 820 gallons of heavy water, into which can be lowered natural uranium rods of one inch diameter, up to a total weight of three tons.

Dean R. R. Laughlin, expressed the general view of the faculty and described the general development of the curriculum, in an article in the "Varsity Graduate" of January, 1957, which is summarized very briefly here.

He traced the existence of the var-

Atomic Reactor at the University of Toronto



ious branches of engineering we know today to a diversification necessitated by the growth of the scientific basis of engineering. This system does not involve the student, for utilitarian purposes, in "greater detail concerning an ever-narrowing field" as it is sometimes supposed. Indeed, the purely informational courses have dwindled towards the irreducible minimum. The need for diversification, Dean McLaughlin wrote, lies in the growth of science itself, and the necessity in any true educational process of requiring the student to study some one discipline in depth". In this process he must "specialize", in one sense of that word, but it is the very mastering of one discipline that equips him to undertake a diversity of activity after graduation.

There has also developed an awareness that an engineer must be more than a technologist, and a resulting activity in providing courses in the engineering curricula designed to supply a broader, non-technical background for the young engineer.

Research and graduate work, which go together, are assuming a growing importance in the life of the faculty. "This is necessary," Dean McLaughlin wrote, "not only for the academic health of the faculty as a unit in the university, which is reason enough, but also because industry will need in increasing numbers young men educated beyond the bachelor's level".

Four academic sessions form the structure of the engineering course at University of Toronto with the three summer sessions being used by the student usually for application of the principles he is learning.

Dean McLaughlin reported that, with over 2,000 students, the school of engineering had "passed the region of satisfactory academic environment" for the students. It was clear that before increased facilities were available, enrolment would have to be restricted. And there was another question also: how far should the faculty be permitted to grow? Not indefinitely large, in the dean's opinion. Development has been evolutionary and it should continue to be so, even in the face of these problems.

The University has a plan for the "University of 1968", which was presented in 1957 by an Advisory Planning Committee, in anticipation of an increase in enrolment from 13,000 to 23,400 in 12 years. A unified campus, as illustrated, is the basis of the plan, with new land and buildings complementing old land and buildings. The plan offers a means of accommodating and teaching the increased number without loss of tone or academic performance. It uses 26 acres of new property west of St. George Street.

A priority schedule of new construction and alteration-rehabilitation projects exists. Under this schedule (which allows for successive stages of preliminary study, detailed design and actual construction) the faculty of applied science and engineering will be affected. New buildings are scheduled for 1959 and 1961, and rehabilitation of old buildings in 1960.

As a result there will be a large addition, virtually a new building, attached to the present Physics Building and facing on St. George Street. Working drawings for this building are now in preparation. Engineering will take over the present Physics Building (McLennan Laboratory) and the Chemistry end of the Wallberg Building (Physics and Chemistry will be housed in new buildings on the west campus). Civil and Electrical Engineering will move into the new

Engineering buildings, with new addition (centre), University of New Brunswick

building, and Mechanical Engineering will take over the present Civil and Electrical Building. Ultimately, the old engineering building will be torn down, but not until the expansion plans are nearly complete.

Increase in Engineering Enrolment University of New Brunswick

When Mr. McMahon Cregan was appointed to give the first lectures in civil engineering at a Canadian university in the winter of 1854, twenty-six students enrolled in the new course which was given in the Arts Building. Freshmen engineering students still receive some of their lectures in this venerable old building. In the 103 years that engineering instruction has been given at the University of New Brunswick, the size of the classes, the variety of special instruction, and the physical plant have grown steadily, if not spectacularly. Until the year 1949, a graduating class in engineering of 60 was huge. This year the university will graduate approximately 45 civil engineers, 20 electrical engineers and 20 mechanical engineers, additional space for engineering instruction. It was decided that the existing buildings must continue to be with the prediction of about a 15 per cent increase next year.

Expanded enrolment resulted in the conversion in 1944 of an old gymnasium building into quarters for the electrical engineering department. In 1947 an addition was made to the building which housed the civil and mechanical engineering departments. These two buildings contained the engineering departments until the fall of 1957 when a building linking the two was put into operation.

Limited funds were made available for capital expansion at the university by the government of the Province of New Brunswick. A new building to accommodate the Chemistry Department was planned and a portion of the amount was made available for utilized and that the most practical, if not the most desirable solution to the problem of increasing the facilities with the least cost would be to construct a building joining the two old buildings. This solution had the very attractive feature of collecting all the engineering departments under a common roof.

The final plan made allowance, considering future needs, for relatively easy expansion of the addition to the north-east where some additional available land exists. The possibility of a wholly new building was beyond the foreseeable future.

The floor area of the addition amounts to 45 per cent of the total provided by all three buildings. Lecture space in the addition is limited to rooms for the intermediate and senior civil and mechanical and the senior electrical students. These rooms are equipped with desks and draughting tables and are also used for calculation type laboratory periods and drawing exercises. The remainder of the addition consists of offices for the staff, laboratories, and space for the heating plant. A central heating plant is planned for the campus in the near future, and when it is connected and in operation, the new 100-hp. high pressure heavy oil fired boiler now used for heating will become available for other purposes.

The new building is of fire resistant construction and is protected from the

Draughting room in Engineering Building Addition

Mechanical Engineering Laboratory

old buildings, which have wood floors and framing, by a series of fire doors. General heating is provided by low pressure steam convectors and unit heaters. The draughting rooms were equipped with unit ventilators using hot water as the heating medium. The units were arranged so that they could at a future time be made to operate during the summer months with cooled water (from a source yet to be provided) giving a limited amount of cooled ventilation air.

The rear wall is of the curtain type with glass block fenestration. A steel frame with open web steel joist was used. Welded spandrel trusses between the floor and window sill were used to support the floor and exterior wall. The trusses were covered with corrugated asbestos lumber. Interior partitions were in general made of foamed slag concrete block.

A rather elaborate electrical distribution system was installed to supply power to the various laboratories. Cable trough systems extend to the various parts of the building with laboratories and individual machines being connected to the system at various points. Single and polyphase alternating current at various voltages and direct current at a variety of voltages is thus available in many parts of the building. Platforms were provided on the roof for use in antenna studies.

On the 26th of November, 1957, the Honourable Hugh John Flemming, Minister of Public Works and Premier of New Brunswick, officially opened the new building. Mr. C. M. Anson, president of the Engineering Institute of Canada, was guest speaker at a dinner held in the Lady Beaverbrook Building.

Courses leading to undergraduate degrees in civil, electrical and mechanical engineering are presently given. Three year preparatory courses in chemical and mining engineering are also given with plans to offer a degree course in chemical engineering and engineering physics in the near future. A complete revision to a five year course (four years after senior matriculation) took place in 1949, the first degrees being granted under this plan in 1952. A thorough study of curriculum in the three degree courses was made last year. Changes were made to concentrate the engineering science courses in the earlier years and to restrict the professional courses to the later years. Further revision of the program in the later years is expected in the near future as more staff become available and the intermediate and senior classes become too large in size to deal with in single groups. Preliminary study is being given to the establishment of degree courses in engineering physics and chemical engineering.

Graduate degrees in courses have been given for a number of years by the electrical department. Next year the first regular graduate students in course in the civil and mechanical departments are expected. Graduate work will be increased as more specially trained staff become available.

Acquisition of a variety of new equipment has been possible through the generosity of interested industries and individuals as well as through regular departmental funds. A grant of approximately $9,000.00 was received this year from the Associated Alumni. This grant will also be used for new equipment. The major addition to civil engineering equipment will be a 300,000-pound Young testing machine. The electrical department has recently acquired an analogue computer and four channel oscilligraph, an elaborate model power transmission system with simulated lines and loads, complete protective relaying and three generators have been constructed by the department. A high quality Collins communication receiver is to be delivered during the summer. Recent additions to the equipment of the mechanical department include a Terry steam turbine, an Orenda engine from the R.C.A.F., and a Rover gas turbine which is expected in the near future. All departments expect to continue work during the coming summer holidays on the completion of laboratory arrangements.

Three new staff members in each of the civil and electrical departments are expected in the fall of 1958. Each of these departments will then have nine while the mechanical department which obtained an additional man in 1957 will continue with a staff of five. In addition, the civil and electrical departments each have one technician and the mechanical department has two.

Present undergraduate enrolment indicates that the major increases in number of students will come in the electrical department. The other departments expect smaller steady increases. A policy of accepting students who have engineering diplomas from other universities, into the fourth year of the civil and mechanical courses was adopted three years ago and is expected to be continued. This policy has resulted in unpredictable sizes of classes. Present indications point to the need for additional space in about five years, or at the time a degree course is offered in chemical engineering.

St. Lawrence Seaway and Power Project

At the end of June 1958, progress on completion of all structures of the power and navigation projects had reached a stage to permit the raising of water in the headpond, on July 1, as originally scheduled at the start of construction in 1954. During the month, employment by Ontario Hydro averaged 2,625 persons, while employment by the New York State Power Authority averaged 3,160 persons.

Progress by Ontario Hydro

With percentage completion to date for the structure at 93 per cent, mechanical equipment 70 per cent, and electrical equipment 55 per cent, on the Canadian half of the international power-house as of the end of June, concrete placing was completed except for the deck of the last three units, 3 transformer bank pockets, parapet walls and deck surfaces. Seven turbine runners had been installed. Four generators were ready for test operation with necessary controls, transformers and power lines. Headgates were all in service. The gap in the downstream cofferdam was of adequate size to discharge tailrace water.

Progress by NYSPA

With percentage completion to date for the structure at 90 per cent, and mechanical equipment and electrical equipment each 90 per cent on the American half of the international power-house by end of June, 99 per cent of the concrete had been placed, including all major placements in the intake, ice sluices and in units 23 to 32 inclusive. General erection on four units was completed and four main transformers were being erected on the power-house deck.

On the Long Sault dam, Stage III concrete placement had been completed with 648,600 cubic yards in place. Fixed gate hoists were being installed and steel for the north guardhouse had been erected. Painting of metalwork and equipment, and electrical and mechanical equipment erection was in progress.

Flooding Sequence

At 4 a.m. on June 30 shipping was cut off between Cornwall and Prescott, Ontario on existing 14-ft. draft canals. At midnight stoplogs were placed in the closure structure after the last downbound vessel had cleared. At 4 a.m. July 1, gates of the Iroquois dam were opened to pass 310,000 cubic ft. per second, while at 6 a.m. the tunnel ports of Long Sault dam were progressively closed.

At 8 a.m. on July 1 cofferdam A-1 above the Long Sault rapids between Sheik and Barnhart Islands was blasted with some 35 tons of explosives, releasing a 30 ft. wave of water which over a three day period would slowly inundate 38,000 acres of land, creating an international lake 35 miles long and five miles wide at its widest point. At 9 a.m. the cofferdam at Ogden Island near Waddington, N.Y. was breached.

With filling of the pool completed July 4, power production was commenced, with two units on the Canadian side, while navigation was resumed on July 5. For the balance of the 1958 navigation season vessels will travel through the old Soulanges canal but will be diverted through the Long Sault canal and the two locks on the American side, and through the new Iroquois Lock.

Progress by SLSA

At the St. Lambert lock all concrete was placed at the end of June, all mitre gates installed and four fenders in place and machinery for all gates delivered. At the Cote St. Catherine lock all concrete was placed except for the grouting of the gate gains in the regulating spillway. Erection of the gates was proceeding.

At the Lower Beauharnois lock all concrete was placed for the lock structure and placing was being continued on the upper and lower entrance walls. Installation of lock gate machinery continued. On the upper Beauharnois lock, placing of concrete was underway for the north and south walls at the upstream entrance and on the lower entrance wall.

On overland portions of the channel above Caughnawaga, portions as completed were being allowed to fill to river level from drainage, with all sections expected to be completed by September. Dredging in Lakes St. Louis and St. Francis was reported to be on schedule though some of it will carry over into 1959. Dredging of the south Cornwall channel to 14 ft. depth was completed. In the north Cornwall channel, dredging to 14 ft. depth was not yet finished but this was not yet necessary for navigation. Dredging continued on the Welland at Port Colborne, Port Weller and Thorold.

Bridges: Awards of contracts are pending on piers for the Nun's Island Bridge across Nun's Island, and for the superstructure across the Seaway channel on the piers poured last year at the south shore.

The final 'jacking' operation on the Jacques Cartier bridge was completed on July 2. For all practical purposes the lifting of the southern end and installation of the new span over the seaway channel had been completed.

On the Victoria bridge work continued on the highway spans across the seaway channel. Four bridge piers had been completed to carry the upstream railway line diversion.

At the Honore Mercier bridge, new spans at the south end of the bridge on the route eastward to Laprairie were completed including the approach embankment at the east end. Seven steel spans were also in place for the northbound lane from Malone.

The new double-track CPR-NYC bridge over the seaway channel was in service.

On the high-level highway bridge at Cornwall, with steel in place for both approaches, decks were being poured. Tower frames for the main suspension span were erected and guide wires strung, soon to be followed by the catwalk, then the spinning of cables.

Report of Tolls Committee

The St. Lawrence Seaway Authority and the St. Lawrence Seaway Development Corporation, in a simultaneous announcement on June 18, made public the proposed tolls which may form the basis of the recommendation to their respective governments to meet the requirements of the legislation of each country.

The main features of the proposed toll structure are as follows:

For each passage through the entire seaway—Montreal to Lake Erie; a vessel will be assessed 6 cents per gross registered ton of the vessel; and, in addition, 42 cents per ton of bulk cargo and 95 cents per ton of general cargo carried.

For each passage—Montreal to or from Lake Ontario only; a vessel will be assessed 4 cents per gross registered ton of the vessel; and, in addition, 40 cents per ton of bulk cargo and 90 cents per ton of general cargo carried.

For partial transit of the new seaway facilities—between Montreal and Lake Ontario—where there are seven locks, the user will be charged 15 per cent of the applicable toll for each lock transited.

For each passage through the Welland canal only; a vessel will be assessed 2 cents per gross registered ton of the vessel; and, in addition, 2 cents per ton of bulk cargo and 5 cents per ton of general cargo carried. In the Welland canal, a partial transit will be assessed 50 per cent of the toll, irrespective of the number of locks used.

Commercial vessels carrying passengers will be charged 50 cents per passenger for each lock transited between Montreal and Lake Erie, in addition to the vessel charge.

The charging of tolls on the Welland canal in order to defray the capital cost of deepening as well as operating and maintenance expenses is a requirement of the St. Lawrence Seaway Authority Act, passed by Parliament in 1951. The Act pertains to a deep waterway between the port of Montreal and Lake Erie.

The suggested tolls should be sufficient to meet all financial requirements as the anticipated traffic develops. It is believed by the members of the tolls committees that the revenue derived will provide for the annual cost of operation and maintenance of the new seaway facilities and of the Welland canal; meet interest charges and amortize borrowed moneys over the next fifty years. They have estimated that in the first year of operation the traffic through the new portion of the seaway would approximate 25 million cargo tons, rising gradually to 50 million tons by 1968. The latter figure has been used for the forty years after the development period, since this is considered to be the workable capacity of the facilities presently existing and under construction between Montreal and Lake Erie. For the Welland canal, the Canadian committee estimates the tonnage of cargo at 40 million in 1959, with a gradual annual increase to 60 million tons in 1968.

The traffic estimates of the committees anticipate a development period extending to 1968, that is, a period of ten years during which there may not be sufficient revenue to meet the annual financial requirements. However, with the proposed tolls and the level of traffic which is anticipated beginning with the year 1968, they say that the annual revenues will be sufficient to compensate for the deficiencies incurred during the development period, and that all other financial requirements will be taken care of within the period of fifty years.

A simple method of toll collection is proposed, based on the necessity of non-interference with prompt passage by any user. Toll collection and invoicing of accounts, as well as the preparation of statistical data, will be assigned to SLSA. SLSDC has agreed to participate and share in the annual cost of these services.

SLSDC will hold public hearings at Washington on August 6, 1958, at which interested parties may express their views on the proposed charges. The SLSA, as a matter of policy, will hold public hearings at Ottawa, commencing the same day.

Canadian Pipeline Projects

Alberta Gas Trunk Line

Contract for 18¾ miles of laterals of 8 inch and 6 inch diameter from Sibbald, Atlee-Buffalo Princess and Steveville fields has been awarded to Preston-Clarke Ltd. The general contract for measuring stations was awarded to Mannix Ltd. Completion date for laterals is August 15. Mannix Ltd. was also awarded a contract for a 20-mile gathering system in Pincher Creek field by B.A. Oil Company.

Work on the main line extension and the Pincher Creek lateral was proceeding rapidly at mid-June, on a contract awarded to Piggott Construction Co. Completion is scheduled for the end of July.

Gas from the Cessford field is scheduled for delivery to Trans-Canada in the fall. Initial capacity of the gas refrigeration plant will be about 125 million c.f.d. though initial output will be about 90 million c.f.d. The plant will also provide some 250 barrels daily of stabilized gasoline. It will cost about $3.5 million. $3 million has already been spent on exploration and development.

Trans-Canada Pipelines

Contracts for installing the first six main line compressor stations were awarded early in June.

Trans-Canada announced on July 5, it will purchase the northern Ontario Pipeline Crown Corporation's main pipeline now under construction between Lakehead and Kapuskasing, Ontario.

Northern Ontario Natural — Twin City Gas

More than $3 million will be invested in welded steel pipes and valves to build gas distribution systems in 34 Northern Ontario communities this summer.

Export of Services

The exporting of Canadian engineering services is discussed in the May 10, 1958 issue of *Foreign Trade** by R. A. Frigon, M.E.I.C. Mr. Frigon listed the opportunities and the benefits, the problems, and some of the solutions already found by Canadian firms already practising in foreign markets. Some of the problems and their solutions are as follows:—

Prospecting for work: knowledge of foreign local conditions; travel, for the personal approach; contact with government services, such as the International Bank, International Finance Corporation, United Nations.

Development of a contract: travel for this purpose; appointment of an agent, or partnership with local firms; knowledge of local business practices, and personnel supply.

Financing: contact with Export Credits Insurance Corporation, a Canadian government agency; contact with initiators of foreign projects.

Execution of the Work: adaptation to foreign environment, as regards personnel, taxes, climate, geology; partnership with foreign firm for this purpose.

A characteristic of Canadian technology has been experience in pioneer development in time of rapid economic and social expansion. Engineering firms may find in foreign markets a solution to the ups and downs in domestic demand, challenge, and an opportunity to give technological assistance to countries in need of it.

Some of the instances mentioned in the report were: frequency conversion work on a Panama Canal lock, by Canadian Comstock Limited, through a foreign operations company; nine years of operations in half a dozen foreign countries, largely in pulp and paper mill development, by Stadler Hurter and Company, consulting engineers; work in Pakistan under the Colombo Plan, by Photographic Survey Corp. Ltd.; aerial mapping in Kenya by Spartan Air Services Ltd.; aerial surveys in the far east by Canadian Aero Service Ltd.; building of a newsprint and specialty paper mill at Khulna, East Pakistan by the Canadian engineering firm, Sandwell & Co. Ltd., consultants, and Provincial Engineering Ltd., and Balfour Beatty & Co. (Canada) Ltd., joint venture contractors; building of a conveyor system for an Indian iron ore development, by Hewitt-Robins (Canada) Ltd.

*Publication of Department of Trade and Commerce, Canada, Queen's Printer, Government Printing Bureau, Ottawa.

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

Engineers of the British Commonwealth Meet in Australia

The fourth meeting of the Engineers Institutions of the British Commonwealth met in Australia from Wednesday, March 19 until Tuesday, April 1. Sessions were held in Sydney, Melbourne and Canberra.

This conference meets every four years, the first meeting being held in London, England, in 1946. In 1950 it was held in Johannesburg, and back to London in 1954, and to Australia in 1958. The likelihood is that it will come to Canada in 1962.

The member countries of the Conference are now United Kingdom, Northern Rhodesia, South Africa, Australia, New Zealand, and India. The Australian Conference was attended by observers from two more countries that are desiring membership. These are Ceylon and Pakistan.

The numbers of people attending these conferences are not large inasmuch as in most instances the maximum numbers consist of two voting delegates from each society. This meant that the entire delegation as far as voting members were concerned consisted of eighteen persons. Observers and guests brought the total to twenty-three.

The meetings in Sydney were held in Science House, the home of the Institution of Engineers (Australia). In Melbourne the sessions were held at the University of Melbourne and in Canberra all sessions were held in the Canberra Hotel.

As well as the business sessions there were several opportunities to

PHOTOGRAPH (taken at doorway of the Institution of Engineers (Australia))

Front row, left to right—I. R. Tait, The Engineering Institute of Canada; J. E. B. Jennings, The South African Institution of Civil Egineers, N. A. Jabbar, vice-president, The Institute of Engineers (Pakistan); T. E. Goldup, president, Institution of Electrical Engineers (U.K.); Sir Arthur Whitaker, president, The Institution of Civil Engineers (U.K.); W. G. Morrison, president, Institution of Engineers (New Zealand); D. M. Myers, president, Institution of Engineers (Australia); T. P. R. Cassad, president, Institution of Engineers (India); C. M. Anson, president, Engineering Institute of Canada; M. Hewitson, president, South African Institute of Electrical Engineers; D. A. Dallamore, president, South African Institute of Mechanical Engineers; H. G. Furphy, vice-president, Institution of Engineers (Australia).

Second row, (left to right)–C. H. D. Harper, secretary, Institution of Engineers (Australia); B. G. Robbins, secretary, Institution of Mechanical Engineers (U.K.); S. Rajanayagam, honorary secretary, Institution of Engineers (Ceylon); D. V. Darwin, past-president (Australia); W. K. Brasher, secretary, the Institution of Electrical Engineers, (U.K.); B. Seshadri, secretary, the Institution of Engineers (India); G. I. D. Hutcheson, vice-president, Institution of Engineers (Australia); B. L. Bedingfield, secretary, New Zealand Institution of Engineers; L. Austin Wright, general secretary, the Engineering Institute of Canada.

Back row (left to right)–A. McDonald, secretary, Institution of Civil Engineers (U.K.); D. D. N. McGregor, assistant secretary, the Institution of Engineers (Australia); A. J. Adams, secretary to the Institution of Civil, Mechanical, Electrical Engineers (South Africa).

visit outstanding engineering projects —one of these was a coach tour to Port Kembla for an inspection of the Australian Iron & Steel Limited plant and the new inner harbour now being built for the same company.

On another day the entire party, the guests of Metropolitan Water and Sewage and Drainage Board, went on a tour of inspection of the Warraganba Water Supply Project. On the return from this trip the party were guests of the Commissioner for Railways and enjoyed a luxurious ride back to Sydney and a delightful dinner.

One of the most interesting trips took the group out of Melbourne by private train to Yallourn where they were met by officers of the various companies there and shown the Yallourn power station, the Yallourn open cut brown coal mine and the briquette works. This was the first time many of the delegates had ever seen brown coal and it was most interesting to see how it was handled and used.

Undoubtedly the most outstanding tour was that which took three days and gave a close-up view of the Snowy Mountain hydro electric and irrigation project. Here the delegates were guests of Sir William Hudson, chairman of the Authority, and were guests of the Authority two nights at different hostels of the billion dollar project.

Subjects discussed at the many business sessions included among others, the following:

Registration of engineers; supply and demand of engineers; definition of engineer and technician; the education and training of the engineer and the requirements of membership of the various institutions.

The contribution of industry to engineering education; post-graduate study; training of technicians; non-professional personnel; the training of overseas graduates.

Reciprocal privileges to visiting members; technical investigations; public relations; relations with non-professional institutions; abstracting services;

Relations with international organizations in the engineering field; conservation of natural resources; impact of new techniques and developments on existing engineering institutions; research, etc.

It is hoped that at one time and another there may be some detailed account of many of these engineering projects published in *The Engineering Journal*. Also arrangements are underway in an endeavour to get the full story of the most remarkable Snowy Mountain project told at the next annual meeting of the Institute. Hence it is that in this short article no detailed references are made to the projects.

For identification of the delegates please see the adjoining picture.

The Institute was represented by its president, C. M. Anson and the general secretary, L. Austin Wright. Irving R. Tait was also present as an observer on behalf of the Institute. Both Dr. Anson and Dr. Tait were accompanied by their wives.

ASME-E.I.C. Education Conference

Ann Arbor, Michigan — October 15 - 16th, 1958

The third Biennial Education Conference of the ASME and E.I.C. will be held at Ann Arbor, Michigan, October 15 and 16, 1958. The theme will be "How Should Industry Aid Engineering Education?"

The first of these activities was held at Clarkson College of Technology, Pottsdam, New York in 1954 with the theme "Trends in Mechanical Engineering Education". The second conference occurred at the University of Western Ontario, London, Ontario in 1956. The topic was "The Continuing Education of the Graduate Engineer". At the conclusion of the 1956 conference, plans were promulgated for the third conference to be held at the University of Michigan, Ann Arbor, in October 1958.

The representatives of the ASME and E.I.C. have met several times in the past year and it has been agreed to schedule events as in the previous conferences and to have four panel discussions, two general luncheons and a social period with a banquet on the evening of the first day. After considerable deliberation, decisions were reached regarding the general theme and topics for the individual sessions, as follows:

Theme — "How should Industry Aid Engineering Education?"

Panel A — The philosophy of co-operation between industry and higher education; Panel B — Continuing education by industry in industry; Panel C — Support by industry of higher education; Panel D — The three moderators will develop the conclusions reached by the conference participants and one of them will be selected to present the results of the deliberations.

It is also expected that two addresses will be given by senior members of the ASME and the E.I.C., possibly by the presidents of these societies.

Attendance is by invitation only. It is not desired to secure large numbers of delegates but rather a reasonably sized group of persons who are really interested in the subject.

The Canadian invitations are generally being restricted to persons in Ontario and Quebec, with exceptions being made in cases of obvious interests. Branches have been asked to submit the names of interested members to headquarters, so that they may be added to those to be invited.

UPADI

The Union of Pan American Engineering Associations (UPADI) will hold its fifth regular convention at the Queen Elizabeth Hotel in Montreal, September 2-6, 1958. The Engineering Institute of Canada, as the Canadian participating body, will be the host society. As such it is responsible for making all the arrangements for the meetings. A special committee of the Institute has been established, with Dr. I. R. Tait as chairman, to implement the Institute's responsibilities in regard to this important function.

UPADI is made up of engineering societies representing twenty three countries in North and South America. Every two years a convention is held, the four previous conventions having been held in Havana, Cuba, New Orleans, Louisiana, Sao Paulo, Brazil and Mexico City. The program consists of a number of formal functions, committee meetings and social events. Considerable emphasis will be placed on the study of problems relating to engineering education in the participating countries. No technical sessions will be held, since the convention is purely administrative and policy-making. It is expected that over two hundred delegates will participate in the Conference.

The Engineering Institute of Canada, in common with each other participating society, will be represented by ten official delegates, to be named by the E.I.C. Council. However, provision has been made for a number of alternative delegates from Canada to attend, and the purpose of this notice is to request any E.I.C. members who would be interested in attending the sessions to advise the General Secretary, so that they may be provided with information.

Reviewing the Institute's Activities

Recent events in which the Institute and its members have taken part.

Russian Engineers Visit Montreal

At the request of the Ambassador of the U.S.S.R. to Canada, His Excellency Dimitri S. Chuvahin, and with the concurrence of the Canadian government, arrangements were made through the Engineering Institute of Canada to organize visits to various industries and projects in the Montreal area during June 16-18, for a group of five Russian engineers.

The names of these engineers, and the subjects in which they were interested, were as follows:

Mr. Victor A. Kargopolov — Machine Building, Foundries

Mr. Jan O. Eger — Building Construction

Mr. Georgi K. Bodunov — Building Materials

Mr. Evgeni G. Dimitriev — Building Materials

Mr. Gennadi S. Boljshakov — Electrical Apparatus

Mr. Eger is a deputy minister of construction for one of the main geographical divisions of the U.S.S.R. Mr. Dimitriev is general manager of a large Russian asbestos production industry. Information regarding the industries they visited was interpreted through Mr. C. E. Stepanov, the Commercial Counsellor to the U.S.S.R. Embassy at Ottawa, who accompanied the group.

Members may participate in Conference

The Power Industry Application Conference has been organized by the American Institute of Electrical Engineers for September 15-17 in Toronto.

This will be the first international conference on this continent specifically dealing with digital computer applications in the power industry.

Members of the E.I.C. are invited to participate on the same terms as A.I.E.E. members. Information is available from Dr. J. Ham, Electrical Engineering Department, University of Toronto, Toronto, Ont.

Awards for Architectural Competition

Kenneth F. Tupper, was present at the ceremony on May 8 of the Bituminous Coal Institute at which winners of the B.C.I. architectural competition received their awards. Dr. Tupper is seen in the illustration, with George Everest Wilson (left), president, Ontario Association of Architects, who congratulated Donald E. Skinner (right), Toronto, winner of first award, and William P. Smith, Toronto, associate engineer who collaborated with Mr. Skinner in the "boiler house" design.

At the luncheon held in Montreal at which the Institute was host to five visiting Russian engineers.

Nuclear Congress, 1959

The Fifth Nuclear Congress is scheduled for April 5-10, 1959, in Cleveland, Ohio. Canadians are invited to present papers in Nuclear Field.

The Engineering Institute of Canada, as a participating society, will provide for the Nuclear Engineering and Science Conference one or more technical papers. Authors are invited to submit summaries (300 to 500 words) of proposed papers. Summaries should be received at Headquarters by October 1, for transmission to the Congress Manager.

Authors will be notified in October of the selection of papers for the program, and will be given specifications for the preparation of manuscripts, to be received by the E.I.C. by November 28.

Interested authors should send summaries to: Dr. Garnet T. Page, The Engineering Institute of Canada, 2050 Mansfield St., Montreal 2, Que.

The President at Philadelphia

Kenneth F. Tupper, president of the Engineering Institute of Canada represented the E.I.C., at the fiftieth anniversary celebration of the American Institute of Chemical Engineers, June 25, 1958, in Philadelphia, Pa.

During a special ceremonial celebration, he presented the president of A.I.Ch.E. with an illuminated scroll conveying the good wishes of the officers and members of the Institute.

British Guest of E.I.C.

Sir George Barnett, chief inspector of factories, of the Ministry of

Labour, Britain, visiting Montreal in May was greeted at an informal luncheon reception on May 5 with the following people participating: R. S. Eadie, C. G. Southmayd, Claude Beaubien, R. L. Dunsmore, J. B. Stirling, R. E. Heartz, S. Ferrabee, and W. S. G. Smele, United Kingdom Information Office.

Sir George was in Canada to attend a convention at Toronto, of the Industrial Accident Prevention Association, and was also visiting local branches of the I.A.P.A. in Toronto.

E.I.C. Represented at International Meeting

The Institute was represented at the sixty-second annual meeting of the American Academy of Political and Social Sciences, Philadelphia, April, 1958.

S. Logan Kerr, M.E.I.C., and William S. Pardoe, M.E.I.C., of Philadelphia, were the Institute's representatives, as they have been many times. William L. Batt, HON.M.E.I.C., was also present and presided at the third session of the meeting.

Many different viewpoints were expressed with respect to the theme, "Asia and Future World Leadership". The sixteen excellent papers are published in the *Annals* of the Academy.

Photographic Exhibit

The winning entries of the 1958 exhibition of photographs have been selected. The exhibition, was one of the features of the 72nd annual meeting of the Institute at Quebec City, Que. Five photographs were selected as the best of the show. They are listed in random order: "105,000-hp. Dominion Francis Runner", Dominion Engineering Company Limited, Montreal. "Burlington High Level Bridge", Bridge and Tank Company of Canada Limited, Hamilton, Ont. "Autoclave in which Metal-to-Metal Bonding and Magnesium Forming is Carried Out", Avro Aircraft Limited, Toronto. "Second Narrows Bridge," Dominion Bridge Company, Limited, Montreal. "Hortonspheroids", Horton Steel Works Limited, Toronto.

CORRECTION

In the June issue of the *Journal*, Month to Month section, under the heading, Athlone Fellowship Winners, 1958, it was stated that D. M. Caughey, S.E.I.C., of the University of New Brunswick, was the choice from that institution. As it was however, Mr. Caughey was unable to accept the award. In his place Hugh W. Walford, S.E.I.C., was named for the Fellowship.

DID YOU KNOW THAT

Last year *The Engineering Journal* circulated 40 million individual pages of technical and other material.

Polish Engineers Honour L. Austin Wright

The Association of Polish Engineers in Canada held a reception on Thursday, June 26, in honour of the retiring general secretary of The Engineering Institute of Canada in their club premises on MacKay Street, Montreal. The feature of the reception was the presentation of a beautiful leather bound portfolio of etchings—fourteen in number, showing famous old buildings in Poland.

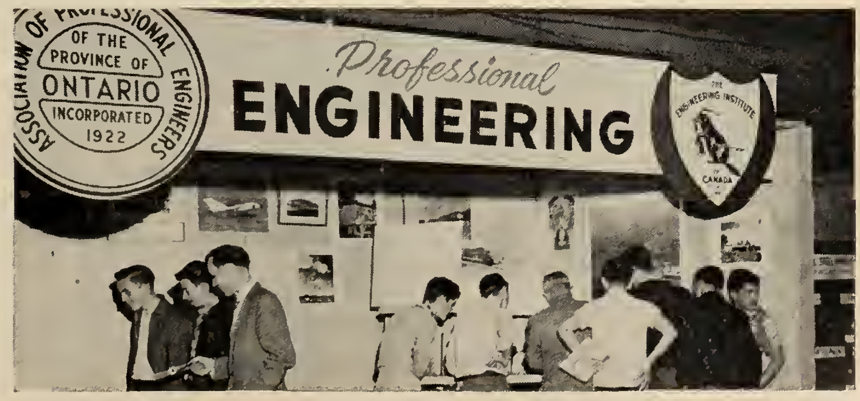
V. Buzek, vice-president of the Association, presided and the presentation was made by Past-President J. Pawlikowski, M.E.I.C. There were about sixty members and their wives present.

Mr. Pawlikowski, in making the presentation, reviewed some of the events that had taken place since the arrival of the first Polish engineers in Canada in 1941. He spoke of the letter of welcome from The Engineering Institute of Canada and the complimentary membership privileges offered them and those who followed them. These things had meant much to the new arrivals in a strange land and had gone a long way towards giving them an appreciation of their new home.

Mr. Pawlikowski recalled that he and most of his associates had passed through the hands of Dr. Wright either in Ottawa or Montreal, at which time Dr. Wright was assistant director of the Wartime Bureau of Technical Personnel. It was on his approval that the Polish engineers were selected for admittance to Canada and it was largely through his efforts that satisfactory employment was found for them on arrival.

On behalf of all his countrymen now established as good Canadians, he expressed thanks and appreciation to the Engineering Institute of Canada and its former general secretary.

A Career Counselling Display, sponsored by the London, Ont., school board was held in that city during the spring for the benefit of high school students. The students viewed the exhibits over a two-day period at scheduled times, in an effort to show what was offered by the various professions. Among those working at the display were professional librarians, accountants, professional soldiers, etc. This photograph shows the joint E.I.C.-A.P.E.O. booth.



Sixth Annual Regional Professional Development Conference, May, 1958

Professional Development Programs

Stride toward Maturity within the E.I.C. Branches

by: Robert L. Wright, JR.E.I.C.
Publicity Co-ordinator,
P. D. P. Co-ordinating Committee

The legion of engineers participating in professional development programs across Canada has been swelled by an additional nine hundred during the past year. The annual reports given by the participating branches at the regional conference revealed the growing impetus of the program. Professional development is becoming of age and is finding its true place in the training of engineers towards the broadening and public-spirited outlook of professional men.

Apparent trends can sometimes be misleading so it is only fair to ask why this movement is so evident within our society. In the post-war years there was a need to rehabilitate the engineering ranks augmented by the additional number of older students. These men were entering the profession at a relatively older age and if they were to understand the responsibilities of their chosen career, some form of training had to be undertaken. Professional development courses were inaugurated to arouse the interest of these engineers. Soon middle and upper management groups, as well as the younger graduates, began to perceive the value of the programs.

Primarily, the function of the program was to bridge the gap between graduation and professional recognition in such a manner as to orientate and integrate the student into the engineering profession. These related problems were eloquently stated by the Committee on Professional Training of the Engineer's Council for Professional Development in 1950.

"The most critical period of the young engineer's whole career is, undoubtedly, the first five years after leaving college. During this period he is finding his place in professional practice, attempting to understand himself, and shaping his professional goals. Frequently, he is establishing his family, and generally his salary is modest. He steps into an organization at a relatively high level and has had no opportunity to understand its problems."

This preliminary program gradually became modified as experience pruned the trimmings and the more basic philosophy shone forth. Experience also demonstrated that unless the young engineer formulated a plan for personal development soon after he left university, he was not likely to ever do so. The core of his plan should relate the basic principles of science and of the humanities to his experience in technical matters and in his association with people. This evolving process is far from complete for, even now, a Co-ordination Committee has been formed to reassess the work done and to plot a course for the future. Most of the programs have had grass-root beginnings with the resultant difficulties but this humble beginning has been essential to the program. Diversity has been the foundation and local need the building blocks. To illustrate the divergence of the programs, one could compare the Sarnia Branch with its ten lectures on "Nuclear Energy" to the Vancouver Branch with its eight lectures on "The Economics of the Province of British Columbia." Both these branches could, in turn, be compared to the Hamilton Branch where a four-year program of twenty lectures each year has been developed, tailored to personality improvement, human relations and business management. Whatever courses will be given in future years, always their ultimate goal will be towards preparing the engineer to shoulder the responsibilities of his profession in society.

A logical question at this point might be—With all this diversity and home-grown course content, how valid are the results? Upon review of the submitted program reports, the validity of the course content has been substantiated, for all program planners have asked and received aid from universities, business organizations and professional men engaged in the fields under review. Many of the lecturers have been top management personnel from organizations actively engaged in the subjects under discussion. Not only does management in general support the program but it has been found that many executives actually participate and, by doing so, not only enrich the program by their mature influence but, in turn, review subjects which may have suffered enforced dormancy.

The Professional Development program extends an invitation to all members of the engineering profession to participate in this rewarding extension of their education. To many, the enforced restriction of an engineering education at university is becoming increasingly apparent but the opportunity for enlarging that education is now presenting itself. Within a few short weeks the majority of branches will be having their registration evenings. Ultimately, of course, the choice rests with the individual, but how long can he afford not to avail himself of supplementary knowledge in this era of rapidly changing techniques, ideas and values. Many will claim the pressure of business makes such a course impractical but one has only to reflect momentarily to realize that the value of an hour's discussion with an expert is worth many hours of factual research. All topics covered in the program are well worth the time given to them for many new facets are revealed at each lecture.

An evening kept free for this coming winter season to join the Professional Development program in your branch will become an enjoyable habit with rewarding dividends. The Professional Development program can function only if the individual members lend their support, so why not investigate its program to see if it can satisfy your goals for professional advancement?

Listed on this page are the names and addresses of ten men, each active in his local Professional Development organization. They have consented to act as advisers to anyone in their area who wishes to contact them.

Should your district not be represented in this group, it may be that their program has not crystallized to the point of supplying us with the required information. The secretary of your local branch can supply you with all the available information.

Professionalism results through service to society. Working on the Professional Development program in your branch area can be an initiation to professionalism. The program committees are usually set up on a rotating basis and there is always an opportunity to be creative. This is an opportunity for all engineers to participate in an interesting and maturing endeavour from which the individual will reap dividends.

SIXTH REGIONAL PROFESSIONAL DEVELOPMENT CONFERENCE

At the Sixth Annual Regional Meeting, Peterborough, May, 1958. Some representatives are shown, left to right: T. E. Flinn, M.E.I.C., chairman, Belleville, W. W. Walker, M.E.I.C., director, Toronto, K. R. Crean, JR.E.I.C., director, Hamilton, Robbin Bowes, M.E.I.C., assistant chairman, Brockville, Robert Wright, JR.E.I.C., assistant director, Niagara, H. R. Sills, M.E.I.C., past president, E.I.C., Peterborough, Colonel L. F. Grant, Hon. M.E.I.C., Kingston, Brian Ahern, JR.E.I.C., chairman, Peterborough, M. M. Brown, JR.E.I.C., chairman, Sarnia.

These Engineers Volunteer Information about Professional Development Work in Their Localities

Brockville

H. L. GILCHRIST,
P.O. Box 1070
Prescott, Ontario.

Calgary

O. O. JUNKER,
c/o Cumming Galbraith Ltd.,
1510a 1st Street S.W.,
Calgary, Alta.

Hamilton

J. A. WALSWORTH,
831 Brucedale Avenue E.,
Hamilton, Ont.

London

A. L. FURANNA,
c/o Public Utilities Commission,
London, Ont.

Niagara

W. J. O'REILLY,
c/o American Canadian Company,
Niagara Falls, Ont.

Peterborough

B. AHERN,
R.R. No. 6,
Peterborough, Ont.

Sarnia

M. M. BROWN,
c/o C.G.E.,
P.O. Box 670,
Sarnia, Ont.

Toronto

W. W. WALKER,
3, The Donway W.,
Don Mills, Ont.

Vancouver

T. H. WHITE,
2461 W. 51st Avenue,
Vancouver, B.C.

Winnipeg

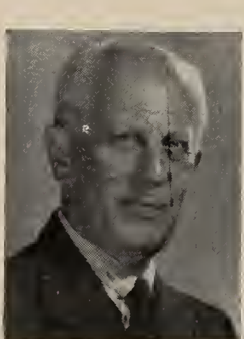
C. S. LANDON,
Room 418,
265 Portage Avenue,
Winnipeg.

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Dr. Francis William Gray, HON. M.E.I.C., of Victoria, B.C., retired assistant general manager of the Dominion Steel and Coal Corporation, Sydney, N.S., died at Victoria, B.C. on June 10, 1958.

Dr. Gray was born at Hoyland, Nether, Yorks, England, on April 15, 1877. He received his higher education at Firth College, Sheffield. After obtaining early experience in the coal mining industry of Great Britain, he moved to Canada in 1904. His first appointment was that of assistant to the general manager of the Dominion Coal Company, Sydney, N.S. In 1908 he was named assistant to the president of the Nova Scotia Steel and Coal Company. From 1919 to 1921 he was editor of The Canadian Mining Journal and Iron and Steel of Canada. Named assistant to the vice-president of the British Empire Steel Corporation, in 1921, he was promoted to assistant to the president two years later, a post he held for five years. He was appointed assistant general manager of the Dominion Steel and Coal Company Limited, Sydney, N.S., in 1928 and continued in this capacity until his retirement in 1945.



Dr. F. W. Gray, M.E.I.C.

Dr. Gray was an outstanding authority on undersea mining, and for his work in this field was awarded an honourary doctor of laws degree by Dalhousie University in 1937.

He was also responsible for the introduction of many improved fire fighting and mine rescue appliances into Eastern Canada. On more than one occasion he was called into consultation by coal mining operators of Western Canada, as well as to act as representative at international meetings in other countries. For his outstanding services and contributions to mining engineering Dr. Gray was at various times throughout his career awarded the Leonard Medal of the E.I.C., the Barlow Memorial Prize of the Canadian Institute of Mining and Metallurgy, the Julian C. Smith Medal of the E.I.C., and the honorary degree of Doctor of Laws by Dalhousie University, Halifax, N.S.

Besides his interest in the Engineering Institute affairs, Doctor Gray found time for other professional engineering organizations. He was for many years a member of The Canadian Institute of Mining and Metallurgy and of The Mining Society of Nova Scotia. He served as president of both organizations. He was elected an honorary life-member of the Association of Professional Engineers of Nova Scotia in 1950. He completed his fiftieth year as a member of the Institution of Mining Engineers of Great Britain in 1954.

He attended two conferences in Europe of the International Labour Organization as a representative of Canadian industry in recent years.

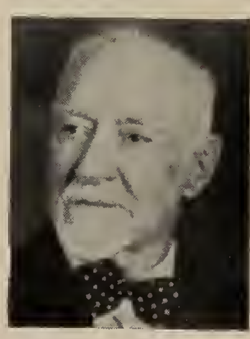
Also, Doctor Gray distinguished himself in many fields not always associated with engineering. He was known for his oil painting, sculpture, writing, both prose and poetry. Many of his works have been published.

Dr. Gray became an Associate Member of the E.I.C. in 1921 and a Member in 1924. He was active in the Cape Breton Branch and served as a councillor of the Institute in 1942. He attained Life Membership in the Institute in 1952. Honorary membership in the E.I.C. was conferred in 1956.

Louis Stanisleau Pariseau, M.E.I.C., retired superintendent of Canals, Quebec, for the federal government, died in his one-hundred and second year at Montreal, on June 7, 1958, after a retirement of more than a quarter of a century.

Born at St. Martine, Laval, Que., on October 23, 1856, Mr. Pariseau received his engineering qualifications with the first class ever graduated from the Ecole Polytechnique, Montreal, in 1877. Immediately he joined the ranks of the professors of that institution. In 1879 he began work with the federal Department of Railroads and Canals as a chainman. He took part in work on the Grenville canal, surveys of the Richelieu river, and surveys for the Lachine canal. He was appointed superintendent of canals for Quebec in 1923. He retired in 1930, well-known as a pioneer in construction methods for public works after fifty-one years of public service.

L. S. Pariseau, M.E.I.C.



At the end of a long career Mr. Pariseau was awarded an honorary degree of Doctor of Applied Science by the University of Montreal and Laval University.

Honoring him on the occasion of his one hundredth anniversary, the E.I.C. presented him with a badge as a token of admiration and respect.

At the grand age of 99 Mr. Pariseau was asked to take part in the laying of a cornerstone for the new building at Ecole Polytechnique, Montreal, his alma mater.

Mr. Pariseau joined the Engineering Institute as an Associate Member in 1887, transferred to Member in 1940. He attained Life Membership in 1917.

Homer Wilson Sutcliffe, M.E.I.C., retired head of the New Liskeard, Ont., firm of Sutcliffe Company Limited, died on March 10, 1958.

Born on April 27, 1884, at Forest Hill, Ont., Mr. Sutcliffe received his general education there and then went on to engineering studies at the University of Toronto where he was a 1907 graduate. He was immediately articled to an Ontario Land Surveyor and received his commission as an O.L.S. in 1908, at which time he entered the firm of Sutcliffe and Nulands. In 1909 and 1910 he took part in the laying of waterworks and sewage systems at Cobalt, Ont. The following year he carried out work for the Province of Ontario. He charted township lines and rivers flowing into Hudson Bay.

In the municipal field he was consulting engineer for New Liskeard, Cobalt, Cochrane, and Timmins, and served Atikokan, Virginiatown and Mattawa in consulting capacities.

He took part in the formation of the Sutcliffe Company Limited in 1924 in association with the late T. S. Armstrong. During his career he located and built several power lines in Ontario and Quebec. He was consulting engineer for the power project at Snare River in the North West Territories.

Mr. Sutcliffe was appointed a member of the Royal Commission for the Province of Ontario in 1943 to enquire into various matters related to the mining industry.

Due to illness Mr. Sutcliffe retired from active practice of engineering in 1953.

Mr. Sutcliffe joined the E.I.C. in 1908 as a Student Member, transferred to Associate Member in 1913, and to Member in 1940. He attained Life Membership in 1948.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

ALBERTA

Annual Meeting Held

The thirty-eighth annual meeting of the Association of Professional Engineers of Alberta held at the Macdonald Hotel, Edmonton, was called to order by President J. C. Sproule, on March 29, 1958. Attending were approximately two hundred professional engineers and engineers in training.

Visitors representing the Ontario, B.C., and Saskatchewan associations were welcomed by the president.

Dr. G. W. Govier reported for the Act and By-laws committee and outlined the steps, taken by the committee to draft a new Act following representations made to the Association by a group of Foresters and a group of Chemists within the province. He reported that this new draft Act has now been prepared and submitted to Council, and there had received approval in principle. The new act would permit registration of other professional physical scientists in an expanded organization. It was pointed out that the draft would permit separate designations for the various professions. Clauses would spell out that only a professional engineer would practice engineering, and only a professional chemist would practice chemistry, etc. Dr. Govier said that both the committee and Council had studied the pros and cons of this proposal and had come to the conclusion that the advantages outweigh the disadvantages, and that no insurmountable problems would be involved in dealing with other professional associations. Only members registered as professional engineers would be allowed to avail themselves of present transfer arrangements under Canadian Council. Dr. Govier pointed out that in Alberta the University Act places the responsibility for assessing applications to various professional associations with the General faculty council of the University of Alberta. rather than with the professional associations. It was suggested that the borderline between pure scientists and applied scientists is diminishing. and that people who have graduated from University in pure science were found practicing along side of engineers. Dr. Govier said the committee, so far has been considering only physical scientists and engineers. The report was adopted.

Reports of the various committees were heard.

Elected for the 1958-59 season were: president, by acclamation, Dr. G. W. Govier, Edmonton, vice-president, C. A. Stollery, Calgary, councillors, for a three-year term, N. J. Allison, Edmonton, Dr. George Ford, Edmonton; W. A. Smith, Calgary; B. F. Wilson, Calgary; councillors for a two-year term, J. C. Scott, Calgary.

Panel discussions on "Should the Association Sponsor Technical Programs," and another which dealt with a series of questions were held. The questions were: 1) How best can consultants serve the public 2) Is the "package deal" good for the engineering profession 3) do contractors and manufacturers supplying free consulting services adversely affect the profession.

BRITISH COLUMBIA

Municipal Engineers' Convention

Annual convention of the Municipal Engineers' Division of the Association of Professional Engineers of B.C. will be held in Prince George on September 18th, 19th and 20th. George P. Harford, P.Eng., City Engineer of Prince George, will be host to over 200 city and municipal engineers, representatives of supply firms, and their wives from 51 communities throughout the province.

The Hon. R. G. Williston, Minister of Lands and Forests, will be guest speaker at the annual banquet on Thursday, September 18th.

Two full days of business sessions will feature papers followed by discussion on a number of subjects applicable to the municipal engineering field, as well as field trips to interesting projects in the vicinity. A pre-convention meeting of the Municipal Suppliers Association will be held in the Prince George Civic Centre on Wednesday, September 17th.

A special ladies' program has been arranged.

ONTARIO

Engineers in the News

Stephen Gramlewicz, P.ENG., formerly with Crompton Parkinson Electric Ltd., in Brantford, Ont. has joined Canadian Line Materials Ltd., Scarborough, Ont., in the capacity of a metalclad switchgear engineer.

Brian G. Butler, P.ENG., has left H. G. Acres & Co. Ltd., Niagara Falls, Ont., to join the atomic energy department of Canadian General Electric Co. Ltd., Peterborough.

D. E. Noble, P.ENG., is project engineer for microwave and industrial products with Canadian Motorola Electronics Ltd., 105 Bartley Drive, Toronto 16, Previous to accepting this position he was with Canadian Radio Mfg. Corp., Toronto.

D. Laschuk, P.ENG., has moved from Chibougamau, Que., to Spragge, Ont., where he has joined the engineering department of Consolidated Denison Mines. He was formerly chief engineer at Copper Rand Chibougamau Mines Ltd., in Chibougamau.

Glenn N. Hutchinson, P.ENG., has left Fort William, Ont., to accept an appointment as an electrical project engineer with Universal Cyclops Steel Corporation at its new mill in Coshocton, Ohio. Prior to accepting this new post he was assistant electrical superintendent at Great Lakes Paper Co. in Fort William, Ont.

Carl J. Jamieson, P.ENG., who has been conducting a consulting mining engineering practice at Chibougamau, Que., is now located in Whitby, Ont., where his postal address is P.O. Box 340, Whitby.

T. M. De Vroom, P.ENG., has left the employ of Dominion Bridge Co. Ltd., to join the development engineering branch, structures division, of the Department of Public Works of Canada, Hunter Building, Ottawa.

Wesley M. Smardon, P.ENG., is now employed in the distribution Standards section of the British Columbia Power Commission, Victoria, B.C.

Mr. Smardon formerly was located in Niagara Falls, Ont., where he was plant engineer of Lionite Abrasives Ltd.

William J. Laskaris, P.ENG., is with the Department of Public Works of Canada and is presently located in Banff, Alta., where he is engaged in engineering administration with the department of highways division.

Personals

News of the Personal Activities of Members of the Institute

Dr. R. L. Hearn, M.E.I.C., (B.A.Sc., Toronto, 1913), has been elected a director of the Brazilian Traction, Light and Power Company, Limited. Dr. Hearn is a director of Atomic Energy of Canada Limited, the British Newfoundland Corporation and the Canada Wire and Cable Company Limited and other companies.

R. F. Shaw, M.E.I.C., (B.Eng., civil, McGill, 1933), has recently been elected president of the Foundation Company of Quebec Limited. This new company, with head office in Montreal, is a subsidiary of The Foundation Company of Canada Limited and has been formed to better serve Foundation clients in the province of Quebec.

Mr. Shaw is executive vice-president of the parent company.

J. H. Mowbray Jones, M.E.I.C., (Toronto, 1927), vice-president and general manager of the Mersey Paper Company Limited has been named president and general manager of the firm, at Liverpool, N.S. He is also a director of the Bank of Canada, Bowater's Newfoundland Pulp and Paper Mills Ltd., Moirs Limited, the Nova Scotia Light and Power Company and the Eastern Trust Company.

Jean St. Jacques, M.E.I.C., (B.A.Sc., civil, Ecole Polytechnique, 1929; B.Sc., McGill, 1931), director of sales and contracts, has been appointed a vice-president and a director of the Quebec Power Company following service with the organization since 1932.

David S. Lloyd, M.E.I.C., (B.A.Sc., elec., Toronto, 1925), formerly a vice-president and director of Pyrofax Gas Limited, a subsidiary of Pyrofax Gas Corporation, has been elected president of the organization. Mr. Lloyd joined the Dominion Oxygen Company Limited, more than thirty years ago. From 1954 to his new appointment he held the office of president of Union Carbide's Linde Air Products Company.

J. M. Courtright, M.E.I.C., (B.Sc., civil, Queen's, 1941), has been appointed Eastern division manager of the Shell Oil Company of Canada, Limited, at Montreal. Mr. Courtright's services have been transferred from Toronto where he was manager, purchasing stores, in the company's head office.

Colonel E. G. M. Cape, M.E.I.C., (B.A.Sc., McGill, 1898), has retired from the office of chairman of the board of the firm of E. G. M. Cape and Company, Montreal. Colonel Cape who established the firm in 1907 will continue to serve as a member of the board.

Brigadier John M. Cape, M.E.I.C., (Royal Military College, 1932), has assumed the office of chairman of the firm of E. G. M. Cape and Company, Montreal, following the retirement of Colonel E. G. M. Cape. Brigadier Cape has been with the firm since 1934. He received the M.B.E. in 1945 after service with the R.C.A. during World War II.

V. A. Ainsworth, M.E.I.C., general manager, Newfoundland Light and Power Company, St. John's, Nfld., has been elected president of the Canadian Electrical Association. Mr. Ainsworth was chairman of the Newfoundland Branch of the E.I.C. in 1956.

Milton Eaton, M.E.I.C., (B.Sc., elec., McGill, 1921), consulting electrical engineer, of Shawinigan Falls, Que., has recently been made a Fellow of the American Institute of Electrical Engineers. Mr. Eaton was the chairman of the St. Maurice Valley section, A.I.E.E., when it had its beginning as a subsection of the Montreal Section.

M. E. Hornback, M.E.I.C.

R. A. H. Hayes, M.E.I.C., (B.Sc., McGill, 1928), of the firm of H. G. Acres and Company Ltd., has been appointed a vice-president of the organization. Mr. Hayes was previously chief engineer, technical division.

Jasper H. Ings, M.E.I.C., (B.A.Sc., civil, Toronto, 1925; C. E., Toronto, 1931), of the firm of H. G. Acres and Company Ltd., consulting engineers, Niagara Falls, Ont., has been made a vice-president of the organization. Mr. Ings who has given more than twenty years service to the company was previously chief engineer on specific projects.

M. E. Hornback, M.E.I.C., (B.Sc., Missouri, 1912), of Montreal, has been named director and consultant to the Simon Engineering Companies of Canada Ltd. Until recently Mr. Hornback was chief mechanical engineer to the Aluminum Company of Canada Ltd., which he served for eighteen years. Earlier he was with the John S. Metcalf Company Limited.

H. A. Oaks, M.E.I.C., (B.A.Sc., mining, Toronto, 1922), has become a partner in the firm of T. A. Richardson and Company, Toronto. Mr. Oaks has had considerable mineral exploration experience in the North country and has operated as a mining consultant, Port Arthur, Ont., area, and as a partner in the Mining Evaluation Company in Noranda.

R. B. Wotherspoon, M.E.I.C., (Royal Military College, 1935), of Kingston, and

D. S. Lloyd, M.E.I.C.

J. M. Courtright, M.E.I.C.

R. B. Wotherspoon, M.E.I.C.

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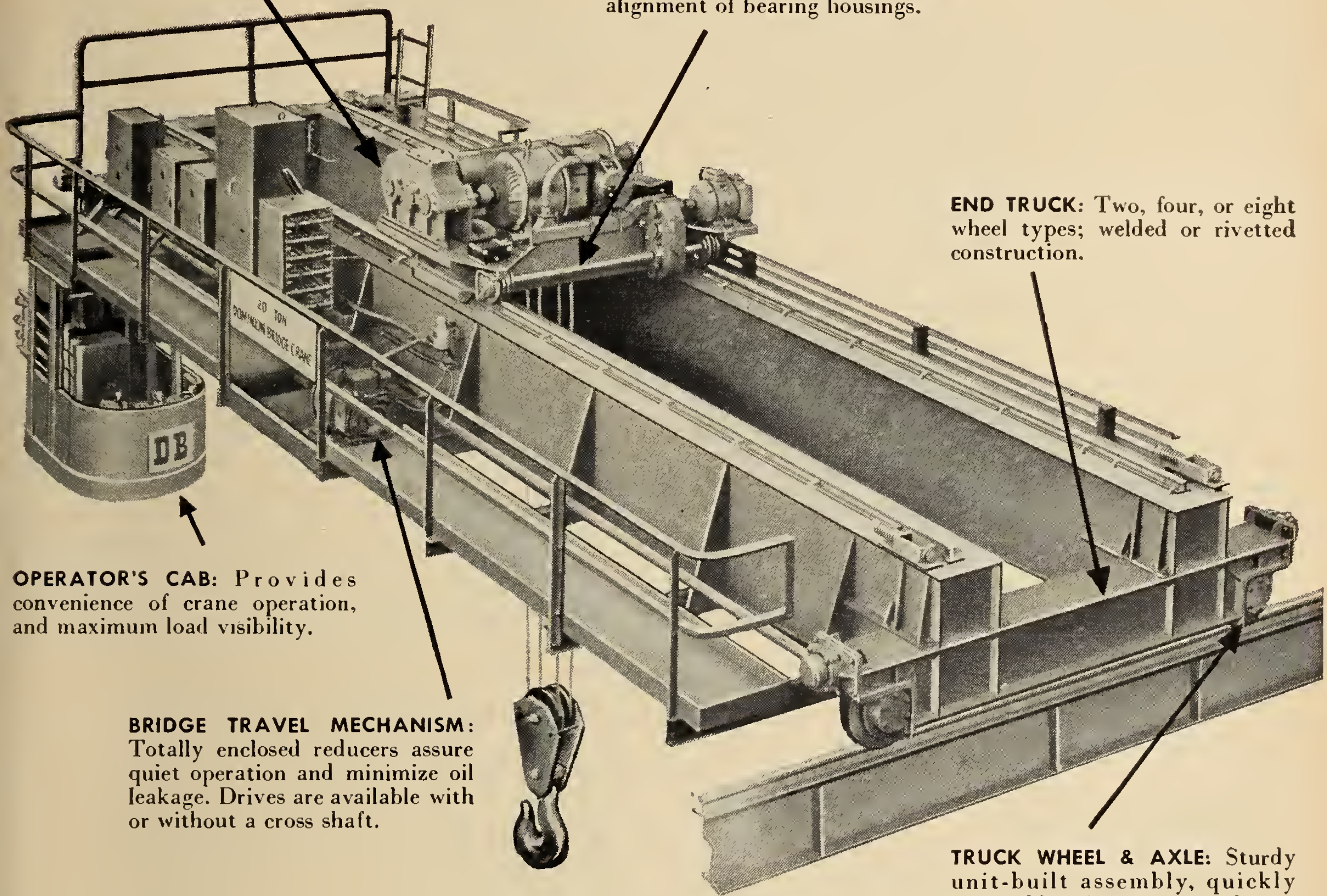

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formerly of Montreal, has been elected chairman of the Kingston Branch of the E.I.C. for the 1958-1959 season. Mr. Wotherspoon is associated with Imperial Chemical Industries of Canada Limited, at Kingston, Ont.

Peter B. MacFarlane, M.E.I.C., It was stated in the June issue of the Journal that P. B. MacFarlane, M.E.I.C., was vice-president and general sales manager of the International Panel Boards Limited. It was also stated that this firm is a wholly owned subsidiary of Atlas Asbestos Company Limited. It is however a subsidiary of the International Paper Company. The Journal regrets the error.

Thomas J. Hogg, M.E.I.C., (B.A.Sc., mech., Toronto, 1947), has joined H. S. Gellman and Company Limited, data processing consultants, Toronto, as vice-president of the firm. Mr. Hogg was formerly engaged in program co-ordination with the Hydro-Electric Power Commission of Ontario.

A. G. W. Lamont, M.E.I.C., (B.A.Sc., chem., Toronto, 1943; M.Sc., Queen's, 1947), has joined W. S. Atkins and Associates Ltd., consulting engineers, Toronto, as chief process engineer. He was previously with A. H. Ross and Associates as a consulting metallurgist.

Over the past eleven years Mr. Lamont has been engaged in a wide variety of uranium and other metallurgical activities in Canada and the U.S., with the Eldorado Mining and Refining Company and Gunnar Mines Ltd., metallurgical division.

D. R. Burns, M.E.I.C.

A. G. W. Lamont, M.E.I.C.

P. S. Jagger, M.E.I.C.

C. D. Smith, M.E.I.C., (B.Sc., civil, Alberta, 1948), has resigned as senior hydraulic engineer of the P.F.R.A., Regina to accept an appointment as associate professor of civil engineering at the University of Saskatchewan. Mr. Smith became associated with the P.F.R.A. design division in 1949 as a designer, and since 1952 has been engaged in experimental research on hydraulic structures.

C. D. Smith, M.E.I.C.

Donald R. Burns, M.E.I.C., (B.A.S.C., mech., Toronto, 1947), has been appointed sales engineer for the hydraulic division of the Dominion Engineering Company, Limited. He has been engaged in the manufacture and sale of hydraulic turbines since becoming a graduate engineer.

Paul S. Jagger, M.E.I.C., (B.A.Sc., mech., B.C., 1944), has taken over the ownership and active management of Asbestos Cement Products Limited at North Sur-

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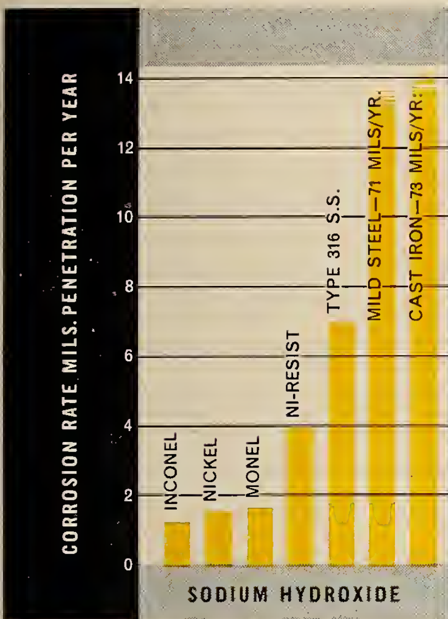
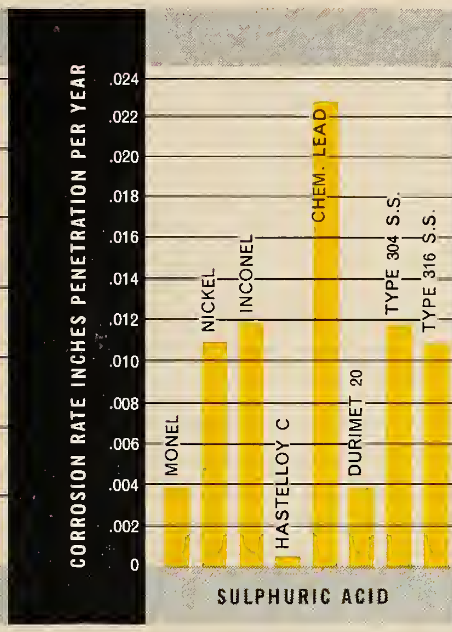


This test was conducted in a plant manufacturing caustic soda. The test spool carrying duplicate specimens of each of the metals shown above was immersed in a solution of 75% sodium hydroxide at a temperature of 275°F. for 35 days.



Plant test in sulphation of vegetable oils with 66° Baumé sulphuric acid and an acid-to-oil ratio of 20-25% by weight at temperatures ranging from 68°F. to 140°F. for a period of 7 Days.

Plant test in distillation of crude fatty acid (cottonseed). Corrosion test spool was located at top of the batch still near the vapour outlet for 42 days. Temperature 480°-520°F.

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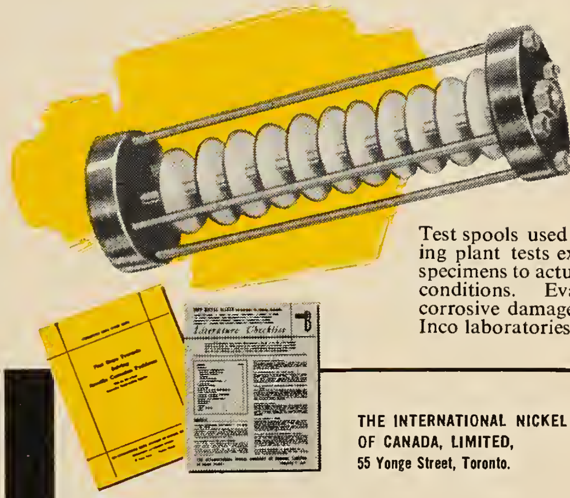

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EJMP-6

rey, B.C. Mr. Jagger has been engaged in the manufacture of building materials in both Eastern and Western Canada for the past fifteen years.

R. F. P. Bowman, M.E.I.C., (B.Sc., civil, Alberta, 1928), formerly assistant superintendent, Canadian Pacific Railway, Minnedosa, Man., has been transferred to Lethbridge, Alta., as superintendent.

Colonel Carl Rice Boehm, M.B.E., M.E.I.C., (B.A.Sc., Toronto, 1929), former head of the Corps of the Royal Canadian Electrical and Mechanical Engineers, and until very recently director of scientific liaison of the Defence Research Board, Ottawa, retired to civilian engineering some months ago, at Victoria, B.C.

J. M. Richardson, M.E.I.C., (B.Sc., elec., New Brunswick, 1941), has been appointed manager-marketing in the motor and control department of Canadian General Electric Company Limited, at Peterborough.

Mr. Richardson brings a broad application and sales engineering background to his new position. For the past two-years he has been manager-sales for the motor and control department.

W. C. Miller, M.E.I.C., (B.Sc., civil, Queen's, 1917), City Engineer of St. Thomas, Ont., for thirty-nine years on June 1 went on leave prior to retirement from the post. After a long vacation Mr. Miller plans to accept a few consulting engagements in municipal work specializing on the problems of the smaller municipalities.

Major C. Ben Bate, M.E.I.C., (B.Sc., civil, Queen's, 1915), has retired from Public Service and has gone into private practice as a civil engineer at Sillery, Que. Major Bate was a plant engineer with the Defence Research Board, Department of National Defence, Quebec, Que.

J. A. Cunliffe, M.E.I.C., (B.A.Sc., ceramic, Washington, 1931; M.Sc., ceramic, Washington, 1932), has transferred from Medicine Hat, to Edmonton, Alta. Formerly with Medicine Hat Brick and Tile Company Limited, he has accepted work with the Northwest Ceramics Limited in the northern city.

W. E. Currie, JR.E.I.C., (B.Sc., mech., Queen's, 1952), has been transferred from Du Pont of Canada Limited, head office, Montreal, to the position of design engineer at the Maitland, Ont., works of the company. Mr. Currie resides in Brockville, Ont.

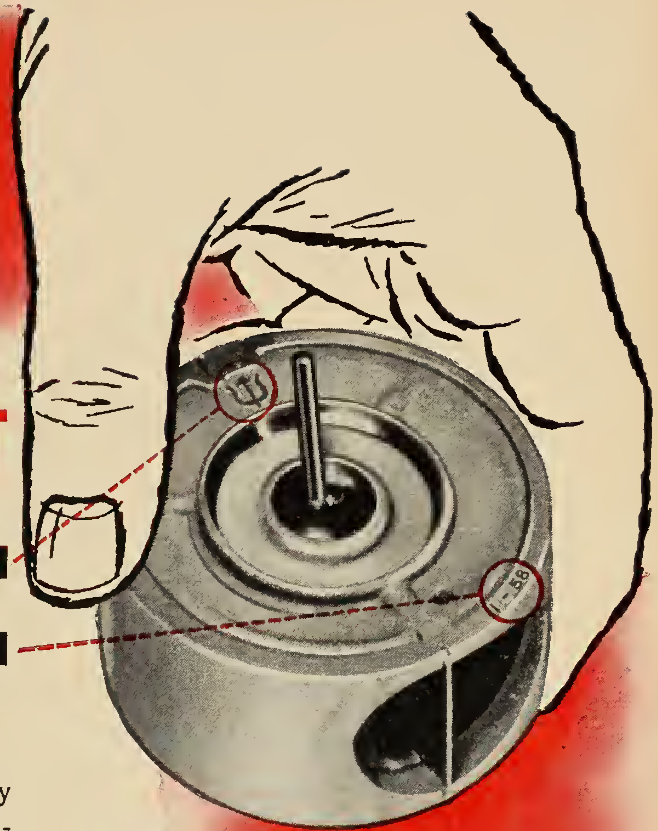
W. G. Gerry, JR.E.I.C., (B.A.Sc., mech., Toronto, 1951, M.Sc., soil mechanics, Colorado State, 1952), has been named to the staff of R. C. Thurber and Associates Ltd., Victoria, B.C. Mr. Gerry has had previous engineering experience with Haddin, Davis and Brown, consulting engineers, Calgary, has operated his own consulting practice in that city and has been associated with the Saguenay-Kitimat Company at Kitimat, B.C.

Flight Lieutenant Paul F. McNichol, JR.E.I.C., (B.Eng., Nova Scotia Technical College, 1950), of the construction engineering branch, A.M.C., Ottawa, has been promoted recently to the above named rank from that of squadron leader.

E. A. Mahr, JR.E.I.C., (B.Sc., civil, Manitoba, 1951), has accepted employment with the Bell Telephone Company of Canada as an engineer. His earlier professional experience included work with the Bituminous Paving Company Limited, Toronto, and the Central Mortgage and Housing Corporation.

Albert Nakash, JR.E.I.C., (B.Sc., civil, New Brunswick, 1952), has founded a construction company under the name of Nakash and Fong Yee Engineering Company Limited, at Kingston, Jamaica. This development in his career follows experience gained with Sprostons (Jamaica) Limited also at Kingston.

G. F. Buck, S.E.I.C., (B.Sc., civil, Alberta, 1958), has accepted employment with the Canadian Pacific Railway as an engineer in bridge design at Montreal.



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NEWS OF THE BRANCHES

Activities of the Fifty Branches of the Institute and abstracts of the papers presented at their meetings

BAIE COMEAU

N. Lapierre, JR.E.I.C., *Secretary*

A SPECIAL MEETING was held in the Manoir Comeau on June 4, 1958, on the occasion of the visit of Dr. J. C. Read, of the British Thomson-Houston Company Ltd., Rugby, England.

Dr. Read joined the British Thomson-Houston Company as an apprentice in 1920, after service with the Royal Engineers in World War I. He worked on the first industrial rectifier built in England in 1926 and organized his company's rectifier division in 1947. Since that time he has held office as manager of the division.

He was responsible for the design of the multi-anode air-cooled mercury arc rectifier installation at the Baie Comeau plant of the Canadian British Aluminum Company which installation is the largest of its type in North America.

Dr. Read, who has travelled extensively, last year visited Moscow with a party of British engineers.

In two parts, the talk was concerned firstly with mercury-arc type rectifiers. Outlining the fundamental principle behind the operation of this type of unit, Dr. Read went on to analyze the various design features associated with rectifier construction, including vacuum preservation, cooling, and the merits of multi-anode versus single anode types of unit. An analysis of the conditions leading to "Backfire" was discussed. Dr. Read concluded his remarks on mercury-arc rectifiers by summarizing the factors which led to the establishment of the particular design of installation used for feeding the Baie Comeau potlines.

Second part of the talk was devoted to the theory and construction of the semi-conductor type of rectifiers with particular reference to germanium and silicon based units. Some of the problems of commercial production were discussed. Dr. Read concluded the talk by assessing the operational and economic limitations of the various types of rectifier unit with particular reference to suitability for use in different sizes of aluminum reduction plants. In this connection he referred to a new plant under construction in France, where germanium rectifier units would be used for 500 volt pot-lines of 100,000 amp. capacity.

It was agreed that Dr. Read's talk, although highly specialized, had been of great interest to members and had provided the most stimulating medium of discussion to date.

Premier L. M. Frost and Professor D. M. Andrews of Great Britain are shown taking part in the opening ceremonies for the new University of Toronto sub-critical reactor held there on June 19, 1958. The reactor which has been installed in the Wallberg building of the University, on College Street, takes up a large part of two floors.

TORONTO

D. S. Moyer, JR.E.I.C., *Sec.-Treas.*

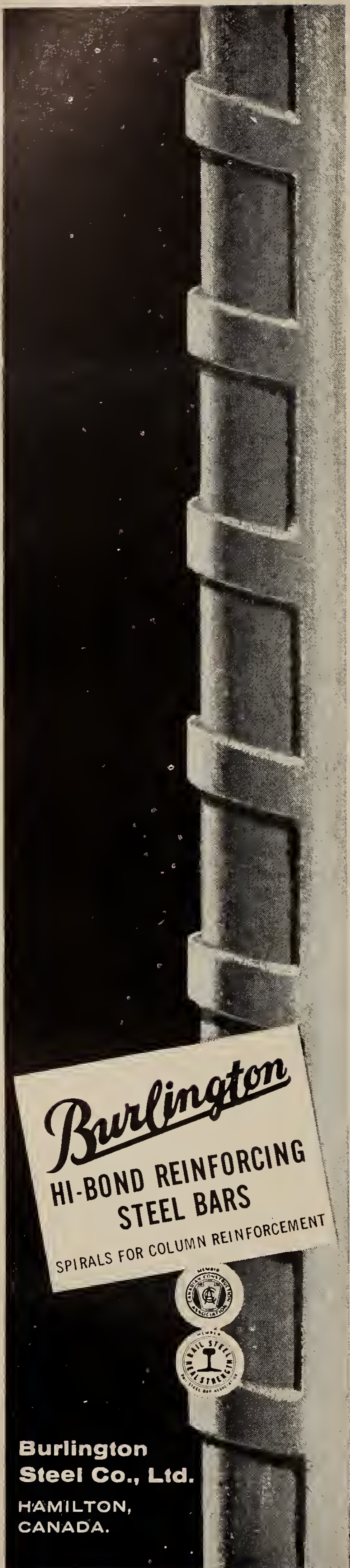
A. C. Davidson, M.E.I.C., *Branch News Reporter*

A $439,000 SUB-CRITICAL REACTOR WAS inaugurated at the University of Toronto on June 19, 1958, with the Hon. L. M. Frost, Prime Minister, Province of Ontario as guest speaker.

The educational purpose to be served by the sub-critical reactor is to provide an opportunity for graduate engineers to study the principles basic to atomic reactors and to gain some experience in the application of those principles by actual experimentation. By definition and design the reactor cannot become "critical", and hence is perfectly safe for instructional purposes. It has limited, but nevertheless significant research potentialities.

In harmony with the policy of Atomic Energy of Canada Limited, it is of the natural-uranium heavy-water type.

It consists essentially of a five-foot diameter tank filled with 700 gallons of heavy water in which are set over one hundred aluminum-sheathed natural uranium rods (three tons) arranged in the form of a lattice, the shape of which may be varied. To provide the necessary neutron concentration a radioactive source is placed when required, directly under the tank and the resulting neutron flux



at various points within the reactor, determined. Such measurements require the use of counting equipment housed in a separate room especially designed for the purpose.

So far as operation and control is concerned, the behavior of a reactor when it is "critical" can be simulated by electronic devices. Such an assembly is available so that students can see, so far as a control room would indicate, what occurs during the operation and control of a reactor during the approach to an arrival at criticality.

In addition to its basic cost of $439,000, of which $200,000 went for heavy water, the reactor will use three tons of uranium, worth $100,000, loaned by Eldorado Mining and Refining Limited, and a radium-beryllium neutron source obtained from Atomic Energy of Canada Limited.

Workings of the reactor were described by Professor Douglas Andrews of Great Britain who has supervised its construction and who will be in charge of its academic use.

Lt. Col. W. E. Phillips, chairman of the board of governors of the University of Toronto was chairman at the inauguration.

LAKEHEAD

George A. Walker, JR.E.I.C.,
Chairman, Publicity Committee

C. M. Cotton, JR.E.I.C., *Sec-Treas.*

THE ANNUAL MEETING of the Lakehead Branch of the E.I.C., was held June 4, 1958, in the Port Arthur Golf and Country Club.

A new slate of officers was presented for the coming year. V. B. Cook, retiring chairman passed the gavel to W. D. McKinnon, newly elected chairman, for a few comments.

J. A. MacLaren, field secretary of the Institute, and Mr. Halter, Lakehead representative to the annual council and general meeting of the Association of Professional Engineers of Ontario contributed interesting comment on the subject of confederation. This movement is followed with interest by the Lakehead group who note that progress is being made. It is also felt that the status of the professional engineer continues to grow in the eyes of the public.

NOVA SCOTIA TECHNICAL COLLEGE

John Devlin, S.E.I.C.,
Student Representative

THE E.I.C. PHOTO CONTEST: During the 1957-1958 term, a portion of the annual grant of $100.00, which the Institute gives to each university granting degrees in engineering, was used to sponsor an E.I.C. photo contest.

Entries to this contest consisted of a photo or photos taken by the student of an engineering project in Canada with which he was associated, together with a short write-up describing the subject. The contest was open to all students at the college, E.I.C. members, and others.

The entries were judged by a committee of faculty and students and the winner was awarded a cash prize of $10.00, which was presented by Professor Max Baker at the annual meeting of the Students' Society. The winning entry by Tom Jeary, senior, mechanical engineering, consisting of three colour photos of aircraft in flight, was reproduced in the N.S.T.C. yearbook, the "Tech Flash." The photos were taken at Gimli, Man., where Mr. Jeary underwent jet pilot training at the No. 1 Advanced Flying School, R.C.A.F., during the summer of 1957.

Placing second in the contest was S. H. James, also a senior, mechanical engineering.

Winner of an E.I.C. photo competition held at the Nova Scotia Technical College was Tom Jeary, senior mechanical engineer student.

The project was considered quite successful, and with the greater interest it helped to stimulate, a much larger and better contest is envisaged for next year.

SASKATCHEWAN SASKATOON SECTION

Reginald Bing-Wo, M.E.I.C., *Sec.-Treas.*

Roger Dupis, M.E.I.C., *Branch News Reporter*

THE PRAIRIE FIREBOARD PLANT at Saskatoon provided the subject for a tour of fifty members on June 5, 1958, following the dinner meeting.

J. E. Hanson, general superintendent in charge of production gave a short description of the operation of the plant. Following this members were guided around the enterprise. A special shift of employees were at work that members might see the plant in operation.

The Prairie Fireboard plant produces soft wallboard from poplar wood pulp.

July Meeting

At a July 5 luncheon meeting of the section J. Snelgrove, resident design engineer at the new Saskatchewan Power Corporation generating station gave a talk highlighting the major equipment of the generating station. After the talk Mr. Snelgrove guided the E.I.C. members through the generating station, pointing out major aspects of the unit. A report on the station was made by R. R. Keith before the annual meeting of the E.I.C. in June 1957.

Reports were also heard on the annual E.I.C. meeting held in Quebec City in June 1958, by Professor J. B. Mantle, of the University of Saskatchewan, and on the meeting of the "Canadian Council of Professional Engineers, held in Vancouver, by W. G. McKay.

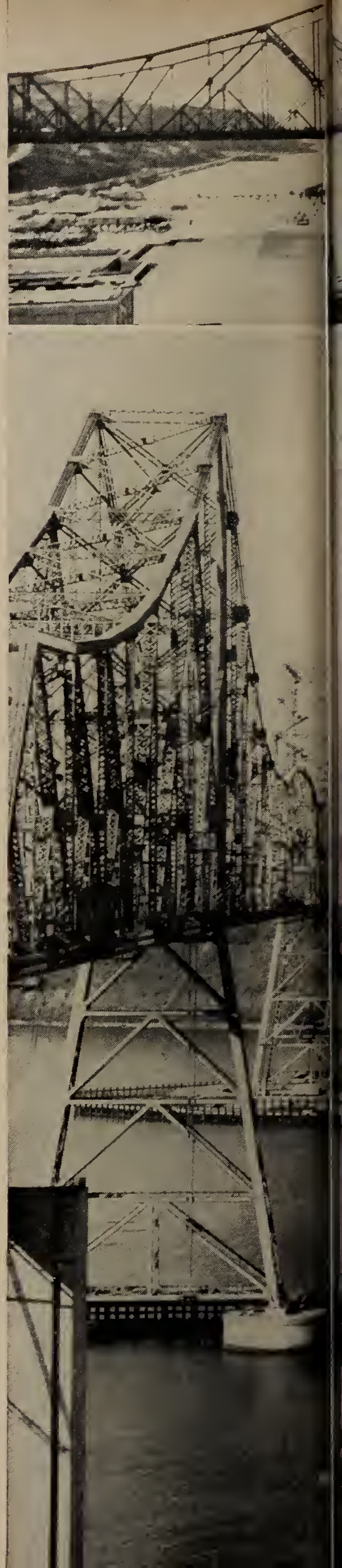
VANCOUVER ISLAND

J. A. Cowlin, JR.E.I.C., *Sec.-Treas.*

H. F. Coupe, M.E.I.C., *Branch News Reporter*

THE PACIFIC NAVAL LABORATORY, Esquimalt, B.C., was toured by the Vancouver Island Branch during May. Dr. W. L. Ford, superintendent of the laboratory delivered an address entitled, "The Role of the Pacific Naval Laboratory." Dr. Ford outlined the operation of the laboratory as a division of the Defence Research Board and explained that the problems dealt with involved investigation of underwater sound propagation, fluid dynamics, geomagnetism, paint and corrosion studies, and consulting work for various branches of the defence department in the Pacific coast area. Following Dr. Ford's talk the group was taken on a conducted tour of the laboratory by staff members to observe the equipment and facilities available for carrying out the laboratory's research program.

D. E. MacLean extended a vote of thanks to Dr. Ford and his staff on behalf of the engineers present for an extremely interesting evening.



News of Other Societies

CGA Meeting Held at Murray Bay

More than 400 delegates and guests attended the Canadian Gas Association's 51st Annual Meeting at the Manoir Richelieu, Murray Bay, Quebec, June 24/27. Dr. H. L. Purdy of Vancouver was elected president for the ensuing year, with N. E. Tanner of Toronto and R. C. McPherson of Calgary as vice-presidents.

Robert W. Otto, president of the American Gas Association, the guest speaker, said U.S. gas reserves had reached a new high in 1957 of some 46 trillion cubic feet and the number of gas appliances in use at year's end approached 100 million. There were 31 million gas consumers in the U.S.

There were many signs that the larger gas appliance manufacturers in the U.S. were preparing to come forward for the first time with a complete line of gas appliances.

E. D. Loughney, senior vice-president B.A. Oil Co., and newly elected director of the Association, pointed out that over the past decade the petroleum industry has spent some $3.2 billion, of which only $1.9 billion had been recovered to date.

Referring to the Gordon Commission's prediction that oil and gas will fill 70 per cent of the nation's expanded energy needs by 1980, Mr. Loughney warned that if the industry had to wait 25 years to market the tremendous reserves already formed, the industry would never mature. He added that if markets are available the industry felt that more than 100 trillion cubic feet could be discovered over the next 25 years.

CTA Meets in Toronto

The Canadian Transit Association held its 53rd annual meeting at Toronto on June 8-11 this year. T. D. Robertson, treasurer, Montreal Transportation Committee was elected president of the association for the forthcoming year, with D. L. MacDonald, superintendent, Edmonton Transit System as vice-president.

General manager H. E. King reported membership included 32 operating member companies, 68 associate member companies and five associates. Revenue passengers carried by 28 operating companies for 1957 totalled 1,043 million, down 3.32% from the previous year. Two companies had reported increases; 13 had reported decreases of 5% or less; 12 companies had reported decreases of from 5% to 10% and one company a decrease of over 10%. Passenger revenue decreased by 2.45% compared with 1956, while combined operating expenses reported by 28 companies showed an increase of 5.82% over the previous year. Ten out of 31 cities served had reported increases in fares during the past year.

The Canadian National Committee of the World Power Conference: back row, left to right: Dr. B. G. Ballard, M.E.I.C., H. L. Briggs, M.E.I.C., L. O'Sullivan, M.E.I.C., D. Cass-Beggs, M.E.I.C., Dr. L. A. Wright, HON.M.E.I.C., A. Ignatieff, R. E. Heartz, M.E.I.C., W. E. Uren, N. Webb, M.E.I.C., Hon. E. E. Fournier. Front row, left to right: T. M. Patterson, M.E.I.C., honorary secretary, D. M. Stephens, M.E.I.C., G. Gale, M.E.I.C., H. Crombie, M.E.I.C., H. Young, M.E.I.C., A. W. Manby, M.E.I.C., and F. L. Lawton, M.E.I.C. (Please refer to Page 78 of this issue for information about the Canadian meeting.)

CALENDAR

Fifth Upadi Convention
Fifth convention of the Union of Panamerican Engineering Associations (UPADI), Queen Elizabeth Hotel, Montreal, September 2-6, 1958.

World Power Conference
Canadian Sectional Meeting, Montreal, September 7-11, 1958.

Sixth International Congress on Large Dams, Hotel Statler, New York City, September 15-20, 1958.

Chemical Institute of Canada
Western Regional Conference, University of Manitoba, Winnipeg, Man., Sept. 4-6.

Society of Chemical Industry
Annual meeting. Includes meeting of American Section and Chemical Industry Medal Award (Sept. 18). Royal York Hotel, Toronto, Ont., and Montreal, Sept. 14-23.

American Institute of Chemical Engineers
38th National Meeting. Hotel Utah, Salt Lake City, Utah. Sept. 21-24.

Community Planning Association National Planning Conference 1958, King Edward Sheraton Hotel, Toronto, Sept. 21-24. Write: C.P.A.C., 77 MacLaren St., Ottawa 4.

Canadian Good Roads Association
C.G.R.A convention, Canada's 39th "Parliament of Roads," Queen Elizabeth Hotel, Montreal, Que., Sept. 30-Oct. 3. Write: C.G.R.A., 270 MacLaren St., Ottawa.

National Northern Development Conference
Edmonton, September 17-19, 1958; sponsored by the Edmonton Chamber of Commerce and the Alberta and Northwest Chamber of Mines and Resources. The speakers will include several well-known members of the E.I.C.

At left; Westeel's "Richmond", free-standing partition. At back and right; Westeel's movable "Hudson" partition.

LIBRARY NOTES

ADDITIONS TO THE INSTITUTE LIBRARY • REVIEWS • BOOK NOTES • STANDARDS

BOOK REVIEW

HYDRO-ELECTRIC ENGINEERING PRACTICE

These three volumes are recommended by the publishers as authoritative sources on modern British and Continental Hydro-Electric design, construction, operation and maintenance, and include the work of some twenty-five specialist contributors chosen principally from the staff of well known British firms engaged in Hydro-Electric engineering.

It is understood that the work has taken ten years to complete. The scope of the three volumes is impressive and represents one of the most comprehensive treatments of the subject produced. The text refers primarily to British and to a lesser extent Continental practice. Whilst it has not been possible to cover all subjects in full detail, the extensive bibliographies given throughout the book should lead the reader to further information on any specific problem encountered. Some indication of the contents of each volume is given in the following notes:—

Volume I is concerned primarily with Civil Engineering aspects, and is divided into three sections. The first deals with "Preliminary Hydraulic Considerations" and covers rainfall and run-off, flow measurements, hydraulics and hydraulic models. The second section is on "Planning of the Scheme" and refers to basic principles of development, overall design and site investigations. The third section forms the major part of the volume and is entitled "Design and Construction of Civil Engineering Works". This includes chapters on dams of all types, spillways, intakes, outlet works, canals, tunnels, pipelines, surge and water hammer, power stations, aesthetic design of hydro-electric structures, and finally, a chapter on the problem of fishery interests.

Volume II is concerned with Mechanical and Electrical Engineering, and is divided into four sections. The first is on "Turbines", the various types, governing and testing. The second section covers "Generators", general arrangement, performance and testing, construction, etc. The third deals with "Control and Transmission Equipment" and covers transformers, switchgear, cables and transmission, and the final section is on "Power Station Planning" and includes planning and layout with specific reference to pumped storage schemes.

Volume III is entitled "Economics, Operation and Maintenance". Under "Economics" the first section, a review of world resources is followed by details of cost analysis, combined operation of hydro and thermal plant, pumped storage schemes and multi-purpose projects. Chapters are included on storage, load prediction and planned development and reports. The second section covers various aspects of maintenance and management, and three appendices are added on wind power, medical aspects of reservoir construction and nuclear power.

The books are well presented and bound, and should find a place on the bookshelf of all Hydro-Electric Engineers. (Ed. by J. Guthrie Brown. Glasgow, Blackie, 1958. 3 vols., 19 guineas.)

R. E. Coxon,
Shawinigan Engineering Co. Ltd.

THE ENGINEERING INSTITUTE LIBRARY

The publications mentioned in these Notes are now available in the Library. Members of the Institute may borrow books, periodicals, pamphlets, etc. from the Library. The loan period is two weeks, excluding time in transit, and two items may be borrowed at one time. Library hours are: Monday to Friday: 9 a.m. — 5 p.m.

Because of a recent change in policy, publications (except periodicals published by other engineering societies) may no longer be purchased through the Library. If members have difficulty obtaining material locally, it is suggested they write to the Library, and the enquiry will be forwarded to an appropriate bookseller. For further information write to the Librarian.

BOOK NOTES

Prepared by the Library, The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

AIDE-MEMOIRE DUNOD: MECANIQUE-PHYSIQUE GENERALE

This sixth edition of a useful handbook has been brought up to date, and includes condensed information on mechanics and vectors, kinematics, statics, dynamics, gravity, fluid mechanics, thermodynamics, and vibration and acoustics. (M. Denis-Papin. Paris, Dunod, 1958. 270p., 480fr.)

*AIR CONDITIONING AND REFRIGERATION

Based on the second edition of the authors' "Heating, ventilating and air conditioning fundamentals", this volume has been considerably rewritten, and in addition contains an added chapter on fluid flow. Emphasis is placed on practical application and problems are included involving the design of an air washer, of hot water heating systems, fan duct systems, and all-year air conditioning systems. (W. H. Severns and J. R. Fellows. New York, Wiley, 1958. 563p., $10.25.)

*ANALYTICAL PHOTOGRAMMETRY

A general analytical treatment of photogrammetry. It begins with the definition of a point in connection with an exposition of the geometric laws of perspective and concludes with the equations for the determination of the position, spatial configuration, and orientation of an irregular object surface without object space control. To provide a general geometric understanding of the basic problems of photogrammetry, explicit and iterative equations are developed for the single and multiple camera stations. (E. L. Merritt. Toronto, Pitman, 1958. 242p., $7.50.)

ALUMINIUM IN BUILDING

The increasing use of aluminum in the building and allied industries has prompted the publication of this book which attempts to bring together the available information on the subject.

After an introductory chapter giving the history of the production of aluminum and its properties, the author

• LIBRARY NOTES

considers its architectural applications as ornaments, wall facings, in entrances and store fronts, doors, partitions, stairways, etc. The use of aluminum in windows and as roofing and cladding is also discussed. The following chapters consider structural aluminum and aluminum buildings, and general applications in piping, kitchen fittings, heating and air conditioning, lighting, etc.

The two final chapters cover the practical aspects of fabrication, forming, machining, riveting, weldings, brazing, etc., of aluminum, and its durability, protection and finish. There are numerous illustrations and a five-page bibliography. (E. I. Brimelow. London, Macdonald, 1957. 378p., 42/-.)

L'AUTOMATIQUE DES INFORMATIONS

An introduction to the principles of automatic machines, especially computers, written by an expert on the subject.

After an introductory chapter to the whole subject of automation, the other topics covered include: the principles of numerical representation; the structure of an analogue computer; the coding of information; the construction of an automatic digital computer, etc.

This is the ninth volume in the series "Evolution des Sciences" issued by this publisher. (F. H. Raymond. Paris, Masson, 1957. 185p., 1600 fr.)

BETON-KALENDER, 1958

The first part of the 1958 edition of this well known handbook contains new tables for uniformly loaded square slabs, and the necessary calculations for road bridges, including DIN 1078.

There are more changes in the second part, where the articles on the following topics have been revised and enlarged: prefabricated building parts of concrete and reinforced concrete; building construction; road construction; superstructures; concrete and reinforced concrete pipelines. (Ed. by Georg Ehlers. Berlin, Ernst, 1958. 2 vols., 19.20 DM.)

CHEMICAL ENGINEERING PRACTICE; V. 4 FLUID STATE

The fourth of a projected series of twelve, this volume is the first of two dealing with chemical engineering operations and processes involving fluid systems.

The book is divided into three sections, the first of which deals with the thermodynamics of physical systems; first and second laws, definitions of thermodynamic functions, properties of mixtures, Joule-Thomson effect and liquid flow, and compression and refrigeration. The second section covers the transport properties of fluids, including fluid statics and dynamics, the flow of viscous fluids, turbulence, boundary layers, flow in ducts, tubes and channels, flow around objects, and the flow of compressible fluids. The last section considers the measurement of pressure, fluid flow and temperature.

Five experts have joined in the writing of this volume. (Ed. by Trefor Davies. Toronto, Butterworth, 1957. 623p., $17.50.)

A GUIDE TO PLASTICS, 2ND ED.

The rapid developments in the plastics industry since the first edition of this book was published in 1951 have prompted the publication of this second edition which has been largely rewritten.

The author describes the different types of plastics and their manufacture, the raw materials used, and the fabrication of finished goods from plastic materials. There are 17 flow charts showing all stages of manufacture of the main categories of plastics, and a list of British Standards on plastics. (C. A. Redfarn. Toronto, British Book Service, 1958. 150p., $4.25.)

*HIGH SPEED DATA PROCESSING

Covers high speed data processors of all types and all manufacturers. There is a detailed study of coding and programming with special emphasis on the value of flow charts in the analysis of

problems. A variety of examples and illustrations are given for typical applications in the major fields. Recent aspects are discussed such as overall reliability and checking of results, use of large random-access stores, and form of files. (C. C. Gotlieb and J. N. P. Hume. Toronto, McGraw-Hill, 1958. 338p., $10.95.)

HUMOR IN DER TECHNIK, BAND 3

This is a collection of anecdotes and jokes in verse and prose, drawn from all branches of technology, and about well known men of science. There are also numerous cartoons. (Comp. by Walter Haas. Essen, Vulkan-Verlag Dr. W. Classen, 1958. 317p., 17.60 DM.)

HYDROMECHANIK

This book, a translation from the Russian, describes the basic problems of technical hydromechanics, with complete mathematical examples. The author relies on the classical analytical methods and basic equations of Euler and Bernouilli, founders of modern hydromechanics, and also gives the latest results of work in this field.

The book is a text for Soviet colleges of water transport, adapted for the German reader, and gives the basic knowledge of hydromechanics required by engineers and technicians interested in waterworks, pipelines and shipbuilding. (M. J. Alferjew. Leipzig, Teubner Verlagsgesellschaft, 1958. 226p., 11.30 DM.)

*INTERNATIONAL ASSOCIATION FOR BRIDGE AND STRUCTURAL ENGINEERING: PUBLICATIONS. VOLUME 17, 1957

Papers dealing with a variety of bridge and structural engineering problems such as the impact resistance on prestressed concrete masts, a general theory of deformations and membrane shells, a theory of prismatic folded plate structures, influence surfaces for moments in continuous slabs over flexible crossbeams, and stress and strain in thin shallow spherical calotte shells. (Zurich, Verlag Leeman, 1958. 268p., 38 DM.)

*AN INTRODUCTION TO THE DYNAMICS OF AIRPLANES

Presents the basic principles and ideas underlying airplane dynamics problems involved in aircraft design, construction, and operation. Because of the importance of vibration problems, the first third of the volume is devoted to this topic while the rest is devoted to aeroelasticity, impulsive loading, flight stability, and miscellaneous problems. (H. N. Abramson. New York, Ronald, 1958. 225p., $4.50.)

*THE MEASUREMENT OF COLOUR

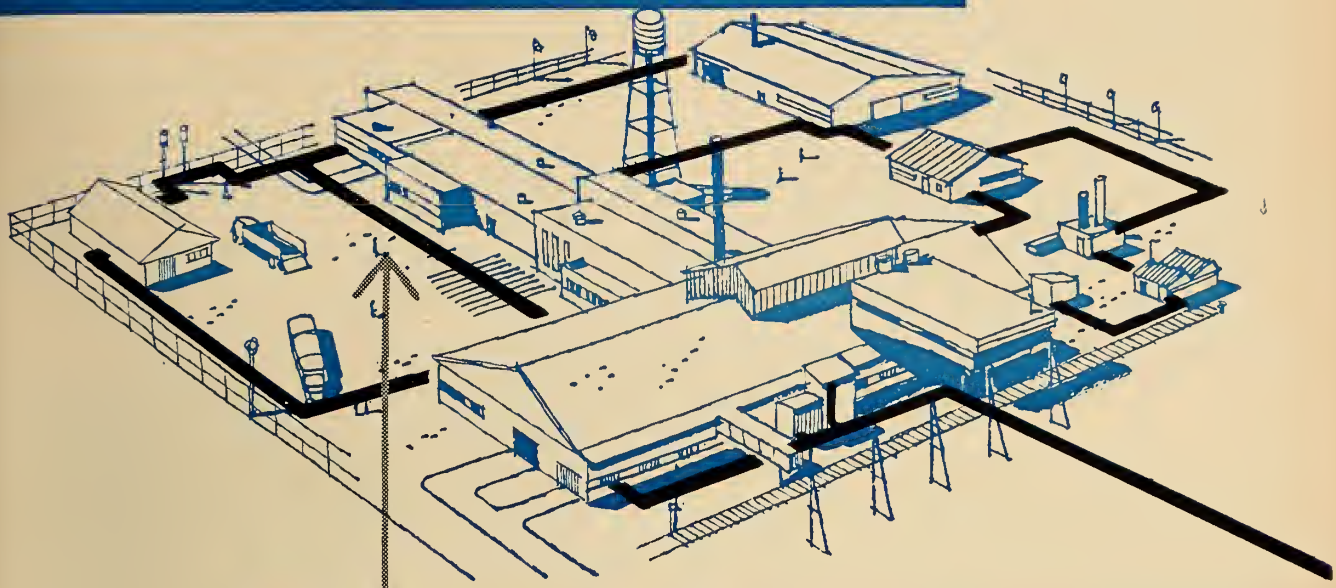
Describes the principles, methods, and applications of the trichromatic system of colour measurement. Areas covered are radiation in the visible spectrum; principles of photometry and colorimetry; colorimeters and spectrophotometers; colour spacing and the colour atlas; colour mixture data applied to three colour reproduction; practical applications of colorimetry. (W. D. Wright. Toronto, Brett-Macmillan, 1958. 263p., $10.75.)

MECANIQUE APPLIQUEE. T.1 MECANIQUE DES FLUIDES

The first of two volumes intended to give students the general basic theories of applied mechanics, this work is concerned with fluid mechanics, treating the subject more as a branch of physics than mathematics.

It covers such topics as the statics and kinematics of fluids, dynamics of viscous fluids, flow in conduits and channels, theory of lubrication, dynamics of compressible fluids, aerodynamics and experimental fluid mechanics. (R. Ouziaux and J. Perrier. Paris, Dunod, 1958. 466p., 2800fr.)

THE MODERN WAY TO TRANSMIT POWER



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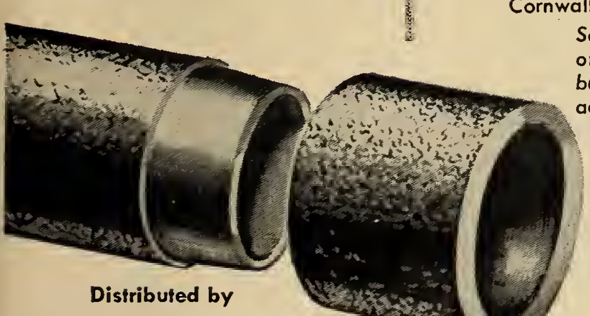

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Business and Industrial Briefs

A DIGEST
OF INFORMATION
RECEIVED BY
THE EDITOR

Appointments and Transfers

Dosco Appointment—A. L. Fairley Jr. has been appointed executive vice-president and a director of the Dominion Steel and Coal Corporation; he will also serve as executive vice-president of the Dominion Coal Company, Limited and the Nova Scotia Steel and Coal Company, Limited, Dosco subsidiaries.

Executive Changes—Canadian Johns-Manville Co. Limited recently announced the following executive changes in the Canadian Products Division of the company: A. G. Sinclair has been appointed assistant general manager; L. M. Adamson becomes general sales manager for the industrial products and pipe sales department; F. A. H. Gallop has been made general sales manager, and G. A. Hall, product manager for the building materials sales department.

Senior Executive Appointments—The appointment has been announced of W. S. Wyman as president of Linde Air Products Company, division of Union Carbide Canada Limited, and of G. W. Patterson as president of National Carbon Company, also division of Union Carbide Canada Limited.

W. S. Wyman

Canadian General Electric—C. E. Hipp has been elected to the board of directors of Canadian General Electric Company Limited, and W. H. Pipe has been appointed secretary of the company.

Aluminum Company—D. W. Evans has been appointed general chemical manager of the new chemical division of the Aluminum Company of Canada Limited, and R. T. Hyland has been made assistant general sales manager, Canadian sales.

Sales Appointments—Canadian Liquid Air Company has announced the appointment of P. Fleming as branch sales manager, Toronto, and J. Saul as manager of gas sales, head office, Montreal.

Simon Engineering—P. N. Veale has been appointed manager of the Montreal offices of Simon Engineering Companies of Canada Limited; W. J. Hopkins has relinquished his post as managing director of the Canadian company to take up a new appointment with the parent company, Simon Handling Engineers Ltd., of Cheadle Heath, England.

G. W. Patterson

P. N. Veale

The Canadian company is concerned in the design and supply of materials handling and storage plants specializing both in the fields of pneumatic and mechanical handling in industry and for port equipment.

Aeroquip (Canada) Ltd. — The appointment of D. A. Rumgay as vice president and general manager has been announced by Aeroquip (Canada) Ltd. Mr. Rumgay was formerly assistant general manager and he succeeds R. W. Bowman, who was acting general manager since the formation of Aeroquip (Canada) Ltd. several years ago. Mr. Bowman has been promoted to another position with Aeroquip Corporation.

B.C. Electric — H. J. Merilees, public information manager of the B.C. Electric Company Limited since 1946, has been appointed executive assistant.

Canadian Westinghouse — The appointment of A. A. McArthur as manager, apparatus sales for the Canadian Westinghouse Company Limited, has been announced. Mr. McArthur, who will be responsible for operations of the company's utility, industrial, and aviation, marine and transportation sales departments, will also provide assistance to the vice president in charge of apparatus and industrial sales, in the commercial activities associated with the development of these markets.

Aluminium Laboratories—A. E. Edwards has been appointed director of research for Aluminium Laboratories Limited, Montreal, succeeding R. H. Rimmer, vice president of the company, who has retired after 36 years of service.

C-I-L Appointment — J. F. C. Dixon has been appointed research manager of the explosives division of Canadian Industries Limited.

J. F. C. Dixon

News of Business and Industry

Plant Facilities Expansion — Barber-Greene Canada, Ltd., Don Mills, Ont., recently completed the expansion of both the physical facilities of their plant and their line of products, which will now include portable and permanent belt conveyors, and certain of the company's ditchers, asphalt mixing plants and railroad car unloaders. The plant was established in 1952 and since then has produced many components of the Barber-Greene line of standardized belt conveyors. The newly completed expansion incorporates a wide range of machine tools, welding, shot blasting and other fabrication machinery, enabling the plant to manufacture in its entirety, any of the Barber-Greene line of conveyors, construction equipment or material handling machines.

High-Speed Graders — A 25-page illustrated brochure giving a description of the design and construction of seven Adams high-speed graders has been produced by LeTourneau Westinghouse Company. Adams heavy-duty graders have an 8-speed constant-mesh transmission, providing eight standard forward speeds and four reverse speeds. For wider speed range, three creeper gears are available — making a total of 15 full-power speeds — in Adams 660, 550, 440, and 330 graders. Copies of the brochure are available through local LeTourneau Westinghouse distributors.

U.S. Products Marketed in Canada — Analogue Controls Inc., Mineola, New York, have announced that their products will be marketed exclusively in Canada by Philips Electronics Industries Ltd., Toronto, Ont. Analogue Controls are manufacturers of high precision potentionmeters, both single and multiturn types. Trigonometric functions are offered to conformities of .015% and linear functions are offered to accuracies of .002%. All models are designed to meet aircraft and missile environmental specifications. Literature is available on request.

Thorium Recovery Plant Contract — The contract for the engineering and construction for what is believed to be the world's first thorium recovery plant has just been awarded by Rio Tinto-Dow Limited to Humphreys and Glasgow (Canada) Limited. The plant will be located on a site adjacent to the Algom Quirke Mine at Blind River, five miles north of Elliott Lake. Humphreys and Glasgow will be responsible for the design engineering and construction of the plant itself and for the installation of the special equipment and machinery needed for the processing of thorium concentrates, thorium sulphates and thorium oxide.

New Dominion Corporation — Allied Chemical Canada, Ltd., a newly established Dominion corporation, have announced that they will be responsible for the conduct and future development of a business backed by an investment in Canada of more than $50 million. Effective on June 1, 1958, Allied Chemical Canada, Ltd., is the successor to the chemical, building materials and related businesses of five long-established Canadian companies: The Barrett Company Limited; Brunner, Mond Canada, Limited; National Aniline & Chemical Company, Limited; The Nichols Chemical Company, Limited, and Semet-Solvay, Limited. Head office of Allied Chemical Canada, Ltd., will be located at 1450 City Councillors St., Montreal.

New Pressure Pipe Plant — The Pressure Pipe Company of Canada Limited, a member of the Canada Iron group, recently opened their new metropolitan Toronto plant at 60 Vulcan Street, Etobicoke. Visitors to the modern 100,000 sq.

ft. Pressure Pipe plant saw the latest in machinery and equipment for manufacture of Hyprescon reinforced concrete steel cylinder pressure pipe and prestressed concrete steel pressure pipe.

Pressure Pipe Company of Canada Limited supplies Ontario and western provinces with pipe and fittings for water and sewage transmission service.

In business since 1932, the company has supplied pipe to municipalities and industries from Halifax to Vancouver. A plant in Montreal serves eastern Canada. Both plants have large storage areas for Hyprescon, available in diameters from 16 in. to 84 in.

Rocol Sales Canadian Export Drive — J. G. Gershon, sales director of Rocol, Ltd., a British firm which develops and manufactures molybdenised and other specialised lubricants for industrial purposes, recently made a two-week's intensive tour of Canada to establish Rocol selling agents.

"Robot" Representation — Canadian Applied Research Limited, Toronto, have announced the completion of arrangements to represent Robot Berning and Co., Dusseldorf, West Germany, manufacturers of fine cameras and accessories. The agreement covers sales and service for Canada in the industrial and scientific fields. The "Robot" cameras have a reputation for engineering and dependability in the amateur and scientific camera field. A complete range of automatic accessories, both mechanical and electrical, inter-changeability of attachments and lenses, is said to make the "Robot" camera the most versatile available on the Canadian market.

Publications

Flame-Cutting Machines — A complete line of "Oxweld" flame-cutting machines are described in a 28-page catalogue available from Linde Air Products Company, Division of Union Carbide Canada Limited. They range in size from small portable models that can be carried around a shop by one man to large multi-blowpipe shape-cutting machines. Also included are complete specifications, illustrations of typical installations, and a description of accessories such as automatic and magnetic tracing units.

Drop Forgings — The Steel Company of Canada, Limited have recently issued a new bulletin entitled "In-formation". This bulletin has been produced to reach those who design, specify or use parts which can be made by the drop forgings process. It will be published quarterly, and sent at no cost to those requesting it.

Air Conditioner Thermostat — The new Robertshaw model "EA4" electric thermostat, a single-pole, single-throw, reverse-acting unit for air conditioners, refrigeration and heater applications, is described in a new bulletin, RT-802, issued by Robertshaw-Fulton Controls (Canada) Limited. Bulletin RT-802 includes a detailed cut-away drawing and installation data, and is available on request.

Skimmer Centrifugal Dust Collector — A new bulletin has been introduced describing the AAF Skimmer dust collector, a centrifugal precipitator. Bulletin 276 (available without charge) includes drawings and photographs which show the AAF Skimmer construction, dimensions, and different arrangements. American Air Filter of Canada Ltd.

Vacuum Arc Furnace — An eight-page publication issued by Canadian General Electric Company Ltd. emphasizes savings in cost and space, reduced maintenance, maximum utilization and manufacturing quality made possible by vacuum-arc melting as a production technique. The three-color bulletin describes the principle used in designing such furnaces and discusses in detail the components, controls and instrumentation of General Electric's vacuum arc furnaces for laboratory, pilot plant and production operations. Cutaway view illustrates key features of the furnace.

Moulded Packing — A new illustrated moulded packing catalogue, No. PK-126A, which describes the design and construction of J-M moulded packings for hydraulic and pneumatic applications, is now available from Canadian Johns-Manville Co. Limited. This catalogue features a cross-section illustration of each available moulded design and gives specific data for rod and plunger applications.

Tellurium Copper — Noranda Copper and Brass Limited have issued a brochure describing the recently developed Noranda tellurium copper. This new alloy contains 99.5% copper and 0.5% tellurium. Noranda states that the addition of this small amount of tellurium has the effect of improving the machinability rating to 90, as compared with 20 for electrolytic copper.

ASEA Journal—The ASEA Journal, the house organ of Canadian ASEA Electric Limited, has been modernized, coinciding with the 75th anniversary of the founding of ASEA. A fresh layout with colour photographs has been adopted

• BRIEFS

and a diversified content will be presented reflecting the widely differentiated activities of the company.

"Franki Facts"—This booklet is mailed six times a year by Franki of Canada Ltd., and each issue deals with a case history taken from various Franki jobs across Canada. All back issues are available.

Lightweight Aggregate Concrete — A 20-page brochure published by The Master Builders Co. illustrates the wide use of lightweight aggregate concrete in modern construction. Photographs and job stories present a clear picture of the wide variety of uses for this relatively new building material. Thirteen construction projects are featured with discussion covering the use of lightweight concrete as a strong, durable structural material for columns, beams and floor slabs, and in multi-story structures, thin shell concrete and bridge decks.

"Products and Processes" — The 1958 edition of "Products and Processes" produced by Union Carbide Canada Limited, has recently been released. The publication describes the varied fields of interest of the company: alloys and metals, carbon products, chemicals, industrial gases, and plastics.

New Aircock Literature — Peacock Bulletin PAC-383, gives up-to-date information and specifications covering the complete line of Peacock aircocks. Spring-loaded inverted-plug aircocks are illustrated with standard screwed or victaulic ends. Lubricated plug cocks for general mill and mine service are also included in the bulletin, which is available free. Made in Canada, these aircocks are available in sizes from ¾" to 4" and are stocked at strategic locations from coast to coast.

New Data Book For Oil Explorers — The use of Kodak linagraph materials in seismic methods of oil exploration is the subject of a new data book, "Kodak Materials for Geophysical Exploration." The 32-page booklet includes a complete description of Kodak linagraph papers, films, and chemicals, plus information on other related products used for geophysical exploration. Also in the booklet are sections on basic processing data, record duplication, storage and handling of photographic materials, and information on how to order materials. The reader will also find a section on helpful hints for processing under field conditions.

Practical Rules on Lightning Safety — The hazardous antics of lightning and means of protecting life and property against this destructive force are contained in a new booklet, "Lightning Facts and Figures," prepared by the Lightning Protection Institute, Chicago, Ill. The colorful, liberally illustrated booklet, easy to read and understand, is available free upon request. It explains

• BRIEFS

in detail how lightning "happens"; how often it is likely to strike in an area; how individuals as well as homes, schools, churches, farms, commercial, industrial, civic buildings and other structures can be protected against lightning loss or damage.

Motor Pulley Drives — A 30-page catalogue, illustrating many actual applications of variable speed motor pulley drives, is now available. The Roto-Cone variable pitch motor pulley operates on a V to V principle. It utilizes an exclusive rack and gear arrangement which imparts a positive and equal linear movement to both pulley discs. Infinitely variable speeds can be changed while the equipment is in operation. Capacities range from fractional h.p. to 20 h.p. Speed ratios range up to 8:1.

New "Siporex" Folder — A new folder on "Siporex" masonry blocks is now available. "Siporex" is a precast cellular concrete combining structural strength with light weight, insulation, fireproofing and easy workability. It is manufactured as reinforced slabs for walls, roofs and floors, and as masonry blocks. The folder describes the properties of this precast building material and gives construction details. It is illustrated and provides detailed tabulations of weights, insulating values, laying dimensions, sound absorption coefficients and sound transmission loss.

Floodlighting — A new 48-page catalogue on floodlighting has just been announced by Canadian General Electric Company Limited, and is obtainable on request. This catalogue contains the latest information on incandescent and fluorescent lighting for a wide range of applications, such as sports fields, service stations, loading ramps, plant areas, industrial yards, advertising posters, fountains and architectural settings.

DISCUSSION *(continued from page 86)*

THE INTERNATIONAL GEOPHYSICAL YEAR

The Engineering Journal, August, 1958.

his second comment about the reduction, correlation and interpretation of data being a vastly greater job than merely taking the measurements. In the final analysis the important advances will be made by individuals or small groups who will apply these data to a great variety of specialized research objectives. Some of these will be accomplished quickly, some will take years. Every effort is being made, however, to see that all data can be made available to anyone who wants it. A description of the organization of World Data Centres would have added a lot more to this already lengthy paper.

CARDE I.G.Y. UPPER AIR RESEARCH PROGRAM

R. F. Chinnick

CARDE, Que.

The Engineering Journal, 1958, Aug. *p.61.*

B. O. Baker,† M.E.I.C.

I welcome the opportunity of congratulating Mr. Chinnick on his paper and to expand on a few of the structural design problems that he mentioned. The model is basically identical to the flying models and will be used for structural testing, design of packages, wiring harnesses, etc. As each experiment in this field is usually very special, there is little or no opportunity of obtaining an already proven body design. Due to the time element, we have little opportunity of production-engineering each design and in fact, if the design concept misses the requirement, little hope of meeting any time schedules exists. Therefore, this first model has been rushed through, to prove as much of the design as possible and permit other groups to design their equipment to suit.

One of the major problems, due to stringent weight and space limitations, is to provide suitable accessability for the Dovap and instrumentation packages, to permit check-out, servicing, etc.

The skin design of this nose cone is of particular interest. Two skins have been used, permitting insulation to be added to combat the transfer of heat from the outer skin. The inner skin is designed as a structural member and is dimensionally stable temperature-wise. The outer skin is designed to permit it to float with the expansions and contractions due to temperature changes. Stainless steel was chosen as the most readily available suitable material that would be easily fabricated.

†Superintendent, Design Wing, Canadian Armament Research Development Establishment, Quebec, Que.

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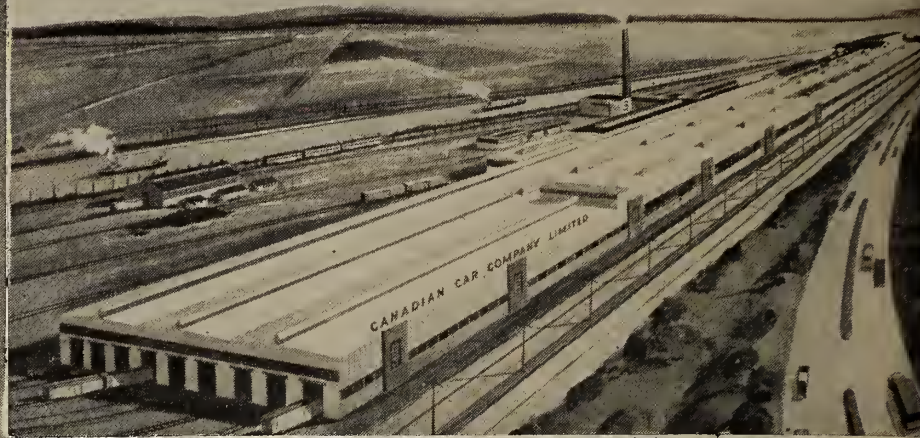

How Franki Caissons overcame marshy, erratic soil conditions

The Franki Caisson

The Franki caisson is a pressure injected footing, with an expanded base forged by blows of 140,000 ft.-lbs. of energy.

In granular soils, the standard Franki caisson will carry a load of 120 tons or more.

The problem:

To erect a plant extension of a type capable of supporting concentrated, heavy loads such as those common to the huge travelling cranes employed by the Company in daily production.

The whole area, at one time a swamp, consists of erratic and lenticular formations of fill, mostly cinder, saturated peat and very soft, silty clay varying in thickness from 9′ to 34′, overlying a limestone bedrock.

The solution:

Due to this lack of uniformity and to the presence of very compressible layers of peat, spread footing type foundations were absolutely unsuitable.

The ability of Franki cast-in-place caisson piles (22″ Ø) to adapt to the bedrock variations, and their high carrying capacity (up to loads of 125 tons), were the main technical factors which, along with a substantial saving in costs, made the Company decide on the Franki solution to this difficult foundation problem.

Literature-This series of job highlights, as well as other descriptive literature, will be sent to you upon request to Franki of Canada Ltd.,

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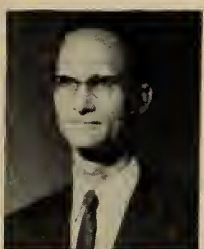
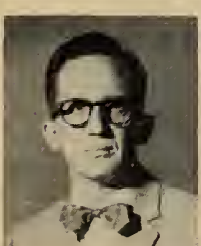
MEET THE AUTHORS

L. H. Burpee, M.E.I.C., Deputy Chief Engineer, The St. Lawrence Seaway Authority, Montreal. *(Planning and Constructing the Lachine Section).* Mr. Burpee graduated from the University of Toronto (B.A.Sc., 1925), and during the early part of his career held positions with Quebec Hydro, Foundation Company of Canada Limited, W. S. Lee Engineering Corporation, Montreal Light Heat and Power Company, Beauharnois Construction Company, Gatineau Power Company, and The Hydro-Electric Power Commission of Ontario. Prior to joining the St. Lawrence Seaway Branch of the Department of Transport in 1952 Mr. Burpee was with Northern Construction Company and J. W. Stewart Limited for six years. He is a member of the American Society of Civil Engineers, The Corporation of Professional Engineers of Quebec, the Association of Professional Engineers of the Province of Ontario, and The Association of Professional Engineers of B.C.



F. L. Peckover, M.E.I.C., Senior Assistant Engineer (Soils), The St. Lawrence Seaway Authority, Montreal. *(Soil and Foundation Problems).* Mr. Peckover holds a bachelor's degree, civil engineering from the University of Toronto (1944). After two years with the National Research Council, he took leave to obtain a master's degree at Harvard University (civil, soils and foundations, 1947), returning to the Council's newly formed Division of Building Research as head of the soil mechanics section; he served as a member of the panel on foundations and excavations, National Building Code of Canada (1953), and as secretary, Associate Committee on Soil and Snow Mechanics. In 1953 he joined The St. Lawrence Seaway Authority, Montreal, and has since been in charge of the soil engineering section, engineering branch. He is an associate member of the American Society of Civil Engineers. *(Photo: Van der Aa.)*



T. G. Tustin, JR.E.I.C., Assistant Engineer (Soils), The St. Lawrence Seaway Authority, Montreal. *(Soil and Foundation Problems).* A graduate in civil engineering from the University of Alberta (B.Sc., 1948), Mr. Tustin did post-graduate study there (soil mechanics and geology), and has since undergone further post-graduate study in business administration at McGill University. He joined the Department of Agriculture in 1949 where he carried out foundation and design studies on the South Saskatchewan Dam. He joined the Columbia Cellulose Company, Prince Rupert, B.C. in 1952, carrying out watershed investigations, and has held his present position since 1954. *(Photo: Van der Aa.)*

J. V. Danys, M.E.I.C., Senior Soils & Foundation Engineer, St. Lawrence River Joint Board of Engineers, Canadian Section, Cornwall, Ont. *(St. Lawrence River Diversion by a Rockfill Cofferdam).* After graduating from the University of Vytautas the Great in Kaunas, Lithuania, in 1939 (civil engineering), Mr. Danys studied hydraulic engineering, soil mechanics and foundations at Munich Technical University, Germany for two years. He was associate professor of civil engineering with the University of Vytautas the Great for four years and later joined the Power Corporation of Canada Ltd., Montreal. Mr. Danys has been connected with the construction of the Power and Seaway Project in the International Section of the St. Lawrence River since 1955.

R. M. Fullerton, Project Engineer, Generating Stations, The Hydro-Electric Power Commission of Ontario, Toronto. *(Electrical Features of the Robert H. Saunders-St. Lawrence Generating Station).* Mr. Fullerton received the degree of B.Sc., electrical engineering, from the Nova Scotia Technical College in 1933, and engaged in electrical construction in the gold mines of Northern Quebec until 1937 when he joined the Northern Electric Company, Montreal. During the period 1938 to 1946 he was associated with the Saguenay Power Company at Arvida, Quebec., the Isle Maligne Generating Station, and the Aluminum Company of Canada, Arvida Works. Mr. Fullerton joined The Hydro-Electric Power Commission of Ontario in 1946; became electrical project engineer for the Otto Holden Generating Station in 1948. In 1952 he transferred to the R. H. Saunders-St. Lawrence Generating Station and in 1954 was appointed to his present position.

A. Matheson, M.E.I.C., Project Engineer, Stations Department, The Hydro-Electric Power Commission of Ontario, Toronto. *Features of the St. Lawrence Transformer Station).* Mr. Matheson graduated in electrical engineering from the University of Manchester in 1924 (B.Sc. (Tech.)), after which he spent five years with Ferguson Pailin Limited, England. He then came to Canada and joined the Canadian Westinghouse Company, Hamilton. In 1938 Mr. Matheson joined Bepco Canada Ltd., Montreal, and in 1940 moved to The Hydro-Electric Power Commission of Ontario, Toronto in the Transformer Stations Project Group of the Stations Department. He is a member of the Association of Professional Engineers of Ontario.

N. J. McMurtrie, Senior Design Engineer, Transmission Department, The Hydro-Electric Power Commission of Ontario, Toronto. *(Design of 230 kv. Transmission Lines).* A graduate in electrical engineering from the University of Toronto in 1945 (B.A.Sc. (E.E.)), and in business administration, 1957 (M.Com.), Mr. McMurtrie spent a year in the R.C.N.V.R. before joining Ontario Hydro in 1946. He was appointed to his present position in 1955. Mr. McMurtrie is a member of the Association of Professional Engineers of Ontario and an associate member of the American Institute of Electrical Engineers.

Major-General H. A. Young, C.B., C.B.E., D.S.O., C.D., M.E.I.C., Deputy Minister of Public Works, Ottawa, Ont. *(Development of Great Lakes Harbours).* General Young graduated from the University of Manitoba in 1924 (B.Sc., electrical engineering), and has spent a long and distinguished career in the Canadian Army. He served in both World Wars, and in 1946 was appointed vice-president of the Central Mortgage and Housing Corporation. In 1950 he became Deputy Minister of Resources and Development and Commissioner of the Northwest Territories, and in 1953 Deputy Minister of Public Works. General Young continues as a director of the Central Mortgage and Housing Corporation; he is a member of the board of governors of the Arctic Institute of North America; chairman, Canadian section of World Power Conference; and president, Royal Canadian Geographical Society.

Historic Inundation Blast at Cornwall Signals Final Stage of St.Lawrence Seaway and Power Project

Canada celebrates opening of key International Rapids Section for navigation, start-up of the Robert H. Saunders-St. Lawrence powerhouse as major engineering achievement nears completion

Loading "Nitrone" blasting agent at the cofferdam. Since some of the charges were placed as much as 3½ months before the July 1st blast, it was essential that they be unaffected by water. "Nitrone" which comes in hermetically sealed steel containers, was accordingly recommended by C-I-L Explosives Technical Service Representatives, seen in the picture above consulting with an Ontario Hydro blaster.

On July 1, 1958, a blast of 30 tons of "Nitrone" breached the cofferdam upstream from the giant new international powerhouse . . . second largest in North America.

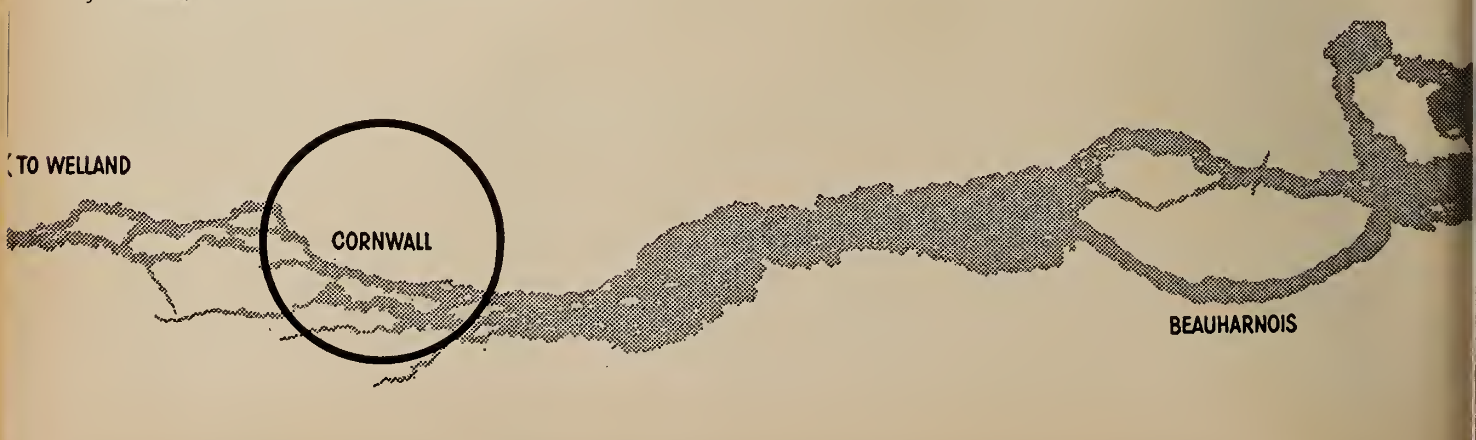
A 35-mile-long lake, ninety feet deep at the powerdam, today covers the site of former towns, villages and farms. The first of thirty-two generating units installed by Ontario Hydro and New York State Power Authority have begun to turn. And shipping will henceforth move through new channels and locks south of the power development.

Some 20,000,000 pounds of explosives used to date

"Inundation Day" climaxed four years' work on one of the world's greatest construction projects. From Montreal westward to the Welland Canal, some 20,000,000 pounds of C-I-L Explosives have been used to dredge and deepen channels; blast excavations for dams and powerhouses; quarry rock for tremendous quantities of aggregate for concrete.

Seaway blasting operations shape Canada's history

C-I-L Explosives have provided the "muscle". And C-I-L men have kept the right quantities of the right explosives moving at the right time to contractors' magazines; have worked with construction companies on big problems and small; have helped get work done on time, at lowest cost. C-I-L is proud to have served on one of the greatest undertakings in our country's history; one which will contribute greatly to Canada's growth and development.



The Construction Period 1954 to 1958

This review records the various agencies and the principal officers involved in the construction of the St. Lawrence Seaway and Power Project. A history of the Seaway from its inception and a record of many of the engineers associated with the project was published in the September 1956 issue of The Engineering Journal, together with several papers on various engineering aspects of the undertaking. A further comprehensive report on the progress of the development appeared in October 1957. Monthly reports have appeared since January 1955.

WITH THE FILLING of the headpond above the International Powerhouse at Barnhart Island near Cornwall during the first week of July, 1958, the billion dollar St. Lawrence Seaway and Power Project entered its final stage. In this special issue of *The Engineering Journal* to commemorate the event it is timely to record briefly the highlights of the construction period now drawing to a close. It is also fitting here to complete the historical review of the project published in our special issue of September 1956, by paying tribute to those engineers into whose capable hands the project passed in August 1954 at the time actual construction was commenced.

It will be recalled that with the passing of the St. Lawrence Seaway Act in 1951 by the Canadian Parliament, Canada had set up a Canadian Seaway Authority to build a seaway navigation channel entirely through Canadian territory, while the International Joint Commission, in October 1952, had approved joint development of the power project by Canada and the United States.

This challenging declaration of intention by Canada to build the navigation channels singlehanded had been instrumental in finally bringing about approval by the U.S. Congress for the joint navigation project, by passage on 13 May, 1954 of the Wiley-Dondero Act. This legislation authorized a U.S. government agency, the St. Lawrence Seaway Development Corporation, to undertake the navigation development through the International Section on the American side of the river.

International Joint Commission

At the time construction was commenced in August 1954, members of the Canadian Section, International Joint Commission, were the Hon. A. G. L. McNaughton, M.E.I.C., as chairman, with Col. J. Lucien Dansereau, M.E.I.C. and George Spence, AFFIL. E.I.C., as members. Dr. D. M. Stephens, M.E.I.C., succeeded Mr. Spence at the time of the latter's retirement in 1957. Members of the United States Section at the time the project was started were the Hon. A. O. Stanley, as chairman, with Roger B. McWhorter and Eugene W. Weber as members. Len Jordan replaced the Hon. Mr. Stanley in 1955, after the latter's retirement in 1954. (Mr. Stanley died on 13 August 1958, aged 91.) Mr. Jordan resigned in 1957 to be followed by Douglas McKay. Mr. McWhorter retired on 31 July 1958.

St. Lawrence River Board of Control

Responsible to the I.J.C. for regulation of the flows of the St. Lawrence is the St. Lawrence River Board of Control. Throughout the period of construction T. M. Patterson, M.E.I.C., was chairman, with J. B. Bryce, M.E.I.C., and Dr. René Dupuis as members, Canadian section. During early stages of construction G. A. Hathaway, U.S. Army Corps of Engineers, was chairman of the American Section, with Frances L. Adams and Bertram D. Tallamy as members. Present members are Brig. Gen. L. G. Rummagi as chairman, with Francis L. Adams and J. Burch McMorran as members.

Joint Board of Engineers

The St. Lawrence River Joint Board of Engineers, which supervises and co-ordinates the engineering of the four 'authorities' within the international and Thousand Island sections, was composed in 1954 of the Hon. Geo. Marler, Minister of Transport, and the Hon. Lionel Chevrier, president, Canadian Seaway Authority, with Max Sauer, M.E.I.C., as chief engineer and member and H. W. Lea, M.E.I.C., who had succeeded Brig. Archer as alternate member. Following Mr. Sauer's death in 1955 Mr. Kohl became chief engineer. Following a change in government in June 1957, the Hon. George Hees replaced Mr. Marler, and Charles Gavsie succeeded Mr. Chevrier as president of the Canadian Seaway Authority and as member of the Joint Board.

Seaway 'Authorities'

Charles Gavsie was himself succeeded in February 1958 by Bennett J. Roberts, C.B.E., at the time of Mr. Gavsie's retirement. Jean-Claude Lessard, M.E.I.C., was appointed in July as vice-president to fill the vacancy left by Mr. Gavsie's elevation to the presidency. C. W. West, M.E.I.C., has remained as a member during the entire construction period. A. Gordon Murphy, M.E.I.C., and Lawrence H. Burpee, M.E.I.C., have continued as chief and deputy chief engineers throughout the life of the project.

Ever since the commencement of the construction period Lewis G. Castle and M. W. Ottershagen have continued as administrator and deputy administrator, respectively, of the St. Lawrence Seaway Development Corporation in charge of improvements to navigation on the American side of the International Section. W. S. Chapin has been general manager, Raymond F. Stellar chief engineer, and L. W. Angell assistant chief engineer.

Power Authorities

In 1954, development of power was undertaken jointly by the Hydro-Electric Power Commission of Ontario and the New York State Power Authority. James S. Duncan, C.M.G., was appointed chairman of the Ontario Hydro following the resignation of Dr. Richard L. Hearn, M.E.I.C., in 1957. Dr. Otto Holden, M.E.I.C., and Gordon Mitchell, M.E.I.C., have remained as general manager, engineering, and chief engineer and project manager, respectively throughout the construction period. Robert Moses, William Wilson, and J. Burch McMorran have continued as chairman, vice-chairman, and chief engineer, respectively, of the New York State Power Authority during the life of the project.

Many Professional Engineers Engaged

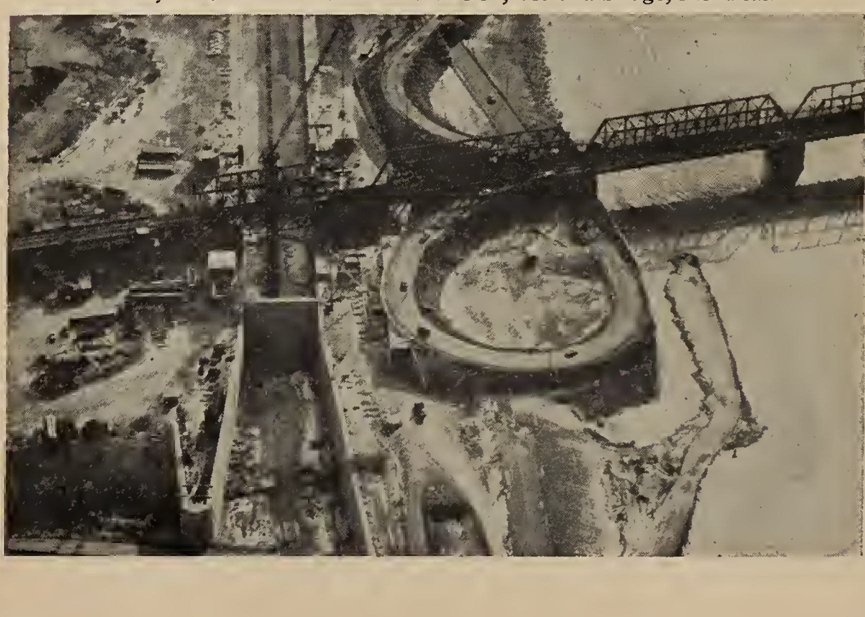
Assisting the executive management of the four 'authorities' during construction were some 475 Canadian and American professional engineers, 120 of whom, on an average, were in responsible charge of design or supervision of construction of the various aspects of the Canadian navigation works, and some 50 of whom were engaged in supervising construction of the Canadian power development, channel improvement, rehabilitation of towns in the areas to be flooded, and various other aspects. Behind them was Ontario Hydro's design staff in Toronto composed of some 66 more professional engineers. The majority of these engineers are members of the Engineering Institute of Canada. (Figures exclude junior engineers.)

On the American side some 35 civilian engineers and members of the U.S. Army Corps of Engineers were engaged in supervising construction of the navigation channels, while design was undertaken by some 30 personnel of the Buffalo section, U.S. Army Corps of Engineers. There were a further 100 American professional engineers or thereabouts engaged in the supervision of construction for the consultants and New York State Power Authority, while some 75 were engaged in design by that Authority and by the consultants to the Power Authority, Messrs Uhl, Hall and Rich, of Boston.

A further undetermined number of professional engineers, both Canadian and American, were employed throughout the design and construction periods by various manufacturers and suppliers of material and equipment, and by the various contractors who were carrying out the work.

Though space does not permit the recording of the names and titles of these men, many of them outstanding members of the profession, each and every one of them may take satisfaction in the part he has played in bringing one of the greatest engineering projects of all time to a successful conclusion.

Seaway construction and traffic diversion, Victoria bridge, Montreal.



Cordial co-operation between the several Boards and Authorities has been conspicuous throughout the construction period, with meetings informal and on a 'first name' basis. Friendly rivalry, such as that between the New York State Power Authority and Ontario Hydro respecting the merits or otherwise of placing concrete during sub-zero temperatures added a zest to the proceedings.

Conspicuous too in the development of engineering design were the economies effected by the use of hydraulic scale models of various stretches of the river at the Islington, Ontario, model testing laboratory by Ontario Hydro during early stages of design. The use of these models was invaluable to designers, and to contractors in planning their construction programs. It undoubtedly resulted in many instances in savings on bids and on costs amounting to a total of many millions of dollars.

Magnitude of the Project

The total cost of the entire seaway and power project based on contracts awarded plus equipment purchased, but exclusive of the $150 million being spent by the U.S. Government for improvement of navigation channels in the Upper Lakes, will amount to somewhere between $1,100 million and $1,200 million. Cost of the power project alone will reach a total of some $650 million, shared approximately equally by the New York State Power Authority and the Hydro-Electric Power Commission of Ontario. Canada's expenditure on navigation facilities will reach a total of $340 million, while U.S. expenditure on navigation facilities will add up to about $141 million.

The entire project involved 166 million cubic yards of dry excavation, 35 million cubic yards of dredging and 25½ million cubic yards of materials placed in dykes. Total concrete placed will amount to about 6½ million cubic yards. The power project involved 82 million cubic yards of dry excavation and 12 million yards of dredging, the placing of some 18 million cubic yards of earth in dykes and the placing of 3½ million yards of concrete.

Eight communities in a 20,000 acres flooded area on the Canadian side, containing a population of 6,500 persons, have been rehabilitated, with 525 homes moved and 450 new homes built, together with new schools, churches, shopping centres, streets and services. Forty miles of mainline double railway track were relocated and 35 miles of new highway built. Ultimately 1,880,000 kw. of power capacity will be installed, divided equally between the New York State Power Authority and the Hydro-Electric Power Commission of Ontario.

The navigation facilities on the Canadian side called for moving 55 million cubic yards of dry excavation and 18 million cubic yards of dredging, 7½ million cubic yards of materials placed in dykes and more than 2 million yards of concrete.

One double track rail bridge, one double track and four-lane rail-highway bridge, and two highway bridges across the St. Lawrence are being raised to provide 180 ft. clearance for shipping by Canada in the Montreal area. A start has also been made at Montreal on the four-lane four-mile long Champlain Bridge across Nun's Island between the city and the south shore of the river.

Navigation channels and locks on the American side called for 25 million cubic yards of dry excavation and 5 million yards of dredging, while concrete placed totalled over 1 million cubic yards. Canada and United States are sharing the construction and cost of a high level highway bridge over the river near Cornwall, Ont., to replace the N.Y.C. rail-highway bridge.

Some Bankruptcies, Some Losses

Many of the successful bids were submitted by 'joint venture' groups composed of leading construction companies with special skills and 'know-how' or with ownership of special suitable equipment. This was the case on both sides of the river. Only in very few exceptions were American firms associated with Canadian contractors doing work on the Canadian side, or vice versa.

Bidders on early contracts on both sides of the river, particularly on excavation, bid the work at prices generally far too low to show them a profit. This was due in part to their desire to become associated with a project destined to get much publicity, and in part to lack of judgment with respect to cost of handling the heavy marine clay and dense till in the foundations.

There were three early failures among contractors on the American side and the work had to be renegotiated at sharply higher unit prices. Elsewhere the cost of excavating tough rock on the Canadian side resulted in losses. Several claims for additional compensation to contractors totalling some $10 million

Long Sault dam site during removal of cofferdam.

have already been met on the American side and others are said to be pending. It is doubtful whether more than a few contracts showed handsome profits.

The summer of 1957 witnessed the period of peak employment, with close to 22,000 persons employed in late summer and early fall on all phases of the project. Little time was lost through strikes, but both labour and some materials were in short supply at times during the construction boom days of 1955/56.

In the main, the original progress schedule has been closely adhered to. Progress on excavation of the Iroquois Lock fell behind in 1955 due to difficulty in excavating the heavy marine clay, but time lost was regained during concrete placing operations. The second stage of the Long Sault dam on the American side got away to a bad start due to several months delay in starting the diversion of the river flow in the spring of 1957, but despite a tight schedule the job was finished on time.

With another 6-7 months to go before the first vessel makes its historic voyage through the new 27-foot draught seaway channels, construction now stands at some 90 per cent of completion. Contracts on excavation are well advanced, work is proceeding as rapidly as hoped for, and no delays are anticipated which would affect the opening date for navigation early in April 1959.

Only on dredging will the schedule not be fully met, and this has been mainly due to the scarcity of dredging equipment, largely because of requirements for improving the upper lake channels by the American government. Another five years will be needed to complete the Beauharnois power and navigation canal between lakes St. Francis and St. Louis, but this will not interfere with navigation next year. Dredging of the channels through these two lakes above and below the canal may have to be acceptable at 450 ft. width during initial stages of operation instead of the full 600 ft. width called for.

All bridge raising operations to give clearance for shipping will be completed before year-end. Only the new Champlain Bridge across Nun's Island at Montreal will not be ready for the opening, but it was never considered as an integral part of the seaway.

(The alternate C.N.R. track at St. Lambert lock will also be completed later.)

On the power project, with four units at least from each half of the International Powerhouse delivering power, the headpond is being held at 4 ft. below full level until the St. Lawrence Board of Control and the International joint Commission are assured that properties along the shorelines are protected.

Some Outstanding Features

Outstanding among accomplishments was the raising of the southern half of the 2½-mile Jacques Cartier highway bridge over the St. Lawrence at Montreal Harbour, to provide 180 ft. clearance for seaway vessels. The roadway profile was changed by jacking the spans and building up the bridge piers on which they rested to increase the clearance by 50 feet.

A further 33 feet was gained by replacing one of the original deck-truss spans with a new through-truss span, built on falsework on one side and slid laterally into place, pushing the old span on to falsework on the other side. This was done in a Sunday morning last October, with traffic closed down for only four hours. The late Dr. P. L. Pratley, M.E.I.C., distinguished Canadian bridge engineer who designed the original bridge as well as this modification being completed this year, incorporated these changes without in any way destroying its artistic or practical value.

Another notable achievement is seen in the smooth working of the gate machinery in the two American locks and in the Canadian Iroquois lock, now opened for navigation. These three giant locks can be filled or emptied in some six minutes with a minimum of disturbance to the water. Similar performance is expected on the other four Canadian locks not yet in service. It compares with a time of some 12 minutes for filling or emptying the older Welland Canal locks built some 25 years ago.

Yet another achievement has been the shortening of the customary dry-out period on the Canadian generators in the International Powerhouse, permitting the first two to be placed 'on-line" within one week following the raising of water in the headpond.

But the greatest accomplishment of all has been the perfect co-ordination between the joint Commission, the Board of Control, the Joint Board of Engineers, the four Authorities and the many contractors and suppliers. This co-ordination has resulted in meeting the exact date set four years ago for first delivery of power and partial opening of navigation through the new locks as scheduled.

Traffic and Tolls

Joint conclusions by the tolls committees of both nations were published in mid-June. Public hearings will follow throughout August and September. The Canadian tolls committee is chaired by J-C. Lessard, M.E.I.C., vice-president of the St. Lawrence Seaway Authority, with George A. Scott and Col. Donald Purves as members. The U.S. committee is chaired by E. Reece Harrill, assistant administrator, S.L.S.D.C., with Dr. Charles Taff and Cmdr. Edward A. Bacon as members. Separate and joint meetings have been held regularly over the past three years, with prime objectives being the lowest tolls consistent with self liquidation within 50 years, a simple toll structure, and the most convenient toll collection method.

Traffic was estimated at 25 million tons in 1959 between Montreal and Lake Ontario, growing to 50 million by 1968; and at 40 million tons through the Welland in 1959, growing to 60 million tons by 1968 and thereafter. Total toll revenue on the Montreal to Lake Ontario section over the 50 year period of $1,254 million would accrue 71% to Canada and 29% to the United States. The entire toll revenue through the Welland Canal estimated at $150 million would accrue to Canada.

Tolls of 4 cents per ton of registered tonnage plus 40 cents per ton of bulk and 90 cents per ton of general cargo were recommended for the Montreal-Lake Ontario portion, while tolls of 2 cents per registered ton plus 2 cents per ton of bulk cargo and 5 cents per ton for general cargo were recommended for the Welland Canal. The entire debt would be amortized by year 2009.

Two Separate Seaways being Considered

There is evidence that tolls for the Welland Canal are being vigorously opposed by the United States. The heart of the matter revolves around the question of whether the Welland is part of the Seaway or merely a connecting channel. Ottawa takes the former view, while the U.S. Cabinet apparently took the same view when it approved U.S. participation in building the seaway. The U.S. Corps of Engineers on the other hand, feels the Welland is a connecting channel. The argument is somewhat academic, however, since only Canada can alter the Welland tolls.

Critics of seaway traffic estimates see the Welland as a future bottleneck. They claim Welland locks will have to be 'twinned' to accommodate the 60 million tons of cargo per season from 1968 on. Estimate of cost for twinning, if traffic demands it, is about $100 million at today's prices. Talk of an 'all American canal' from the south shore of Lake Erie across country to Buffalo, New York, to bypass the Welland, has increased lately and Congress has authorized the U.S. Army Corps of Engineers to make a study of it. Its cost is variously estimated at from $300 to $600 million.

Canada, too, may eventually have an all-Canadian Seaway. When it was agreed in 1954 that the United States would build two locks for the Seaway on the American side, Canada announced her intention of building a canal with two more locks on Canadian soil "if and when it considers parallel facilities are required to accommodate existing or potential traffic." The north Cornwall Island channel now being dredged to improve flows is partly a step in this direction.

Threats for the Future

Two other threats to the Seaway's future more immediate than questions of duplicate navigation channels and locks, are facing the "big ditch". One of these is a recent disclosure by President Eisenhower that the U.S. portion of the Seaway will soon come under the jurisdiction of the U.S. Department of Commerce instead of under the U.S. Army Engineers as at present. U.S. seaway supporters, fearing the tampering with tolls, have fought against the change, lest U.S. railroads may be able thereby to exert influence to get higher tolls or to throw roadblocks in the way of seaway shipping. Best way for Canada of countering such a threat is to have an all-Canadian navigation route in being as a standby, or at least ready to be undertaken.

A second threat is the vast transportation federation planned by Hoffa's International Broatherhood of Teamsters, embracing workers in every field of industry with their partners the International Longshoremen's Union and the National Maritime Union. Such a labour tie-up, if its influence were extended to embrace Canadian Unions, would wield a power that could affect every industry in the U.S. and Canada. The Seaway, being a new field, offers the best opportunity to get a start with this master plan.

Official Opening of the Seaway

Her Majesty Queen Elizabeth II has graciously expressed her willingness officially to open navigation on the new Seaway next spring. Being, as it is, a joint national project, it is probable that President Eisenhower will participate in the ceremonies. Ceremonies, protocol and itineraries are customarily handled through Canada's Department of External Affairs. While there is as yet no specific information regarding the event, plans for the official opening are now in the hands of a special committee responsible for the itinerary of Her Majesty during her tour of Canada in 1959.

The Royal Party might travel through the new Seaway to the head of the lakes in the Royal Yacht *Britannia*. Prime Minister Diefenbaker has announced that the Queen's visit will last about six weeks, from mid-June 1959, and will take in 'all parts of the country'.

Planning and Constructing the Lachine Section

L. H. Burpee, M.E.I.C.
Deputy Chief Engineer, The St. Lawrence Seaway Authority

THE LACHINE SECTION covers that part of the Seaway extending from Montreal Harbour to Lake St. Louis, in which there is a lift of around 50 feet from the Harbour water level to the Lake. The canal is 27 ft. deep at low water level and has a length of 18.5 miles, and has two locks which are at St. Lambert and Côte Ste-Catherine.

The purpose of this paper is to explain the general planning of the Lachine section of the Seaway, and to describe some of the more important construction problems which had to be met and the methods of dealing with them.

The Lachine section is being constructed entirely as a navigation project, but with a number of features arranged and designed so as to permit the future development of power without any serious difficulties being caused by the present navigation works. Nearly two thirds of the cost of the Canadian part of the Seaway is for work in this section.

Prior to about 1950, all planning was based on a canal on the north side of the St. Lawrence River. By 1950 it had become apparent that, due to the very extensive development of the Montreal side of the river, the construction of a canal there would be costly and impractical. In 1952 the decision was made that the Seaway would be constructed along the south shore of the river. Detailed surveys and planning were commenced at that time.

Many variations of channel location and positions of locks were possible. Many studies and estimates were made before the final layout was adopted (Figure 1).

Paper received 4 August 1958.

Location of Canal

There was no choice as to the Seaway location at Victoria bridge as the canal and the lift span had to be located between the last pier and the south abutment of the bridge. Any other location farther out in the river would have caused excessive flow restriction, and would have encroached on the space which will be needed by Quebec Hydro when the future power development is constructed there. Any location south of the existing abutment would have cut heavily into the City of St. Lambert and been far more costly.

The purpose of this paper is to explain the general planning of the Lachine section of the Seaway, and to describe some of the more important construction problems which had to be met and the methods of dealing with them.

Jacques Cartier bridge had a downgrade between St. Helen's Island and the south shore. The spans nearest to St. Helen's Island are 250 feet, and those towards the south shore vary from 200 feet down to 125 feet at the abutment. For the easiest adaptation of the bridge to suit the Seaway, the channel had to be located at one of the 250-foot spans, and for uninterrupted traffic the bridge had to be raised. It was decided that the Jacques Cartier bridge could be raised to provide a high level crossing. The best location for the Seaway was through the last of the 250-foot spans, or between piers 9 and 10. This location will cause very little restriction to the river, is suitable for a modified highway approach system, and provides a good alignment at the junction with Montreal Harbour.

The Seaway channel follows around Laprairie basin at distances from shore varying from 1,000 feet to 2,500 feet. The actual location of the channel was selected after many estimates of quantities and costs, and after many studies of suitable navigation alignment.

From Côte Ste-Catherine to Caughnawaga the channel had to be located overland, as the Lachine Rapids could not be obstructed. The actual selected location has been based on providing sufficient space between the Seaway and the river shore for a future enlargement of the river cross-section by Quebec Hydro for the Lachine power development.

From just west of the Canadian Pacific Railway and around Caughnawaga village, the channel has again been located in the river. The cost would have been prohibitive and the number of persons displaced would have been too great to have constructed the channel overland through the town. It was important to keep the restriction of the river to a minimum, and the canal follows close to the shoreline.

In addition to the canal and locks, the Lachine section required the following modifications to existing features or construction of new features.

Raise Jacques Cartier bridge.
Provide lift span for Victoria bridge.
Modify various existing municipal water supply and sewage discharge systems.

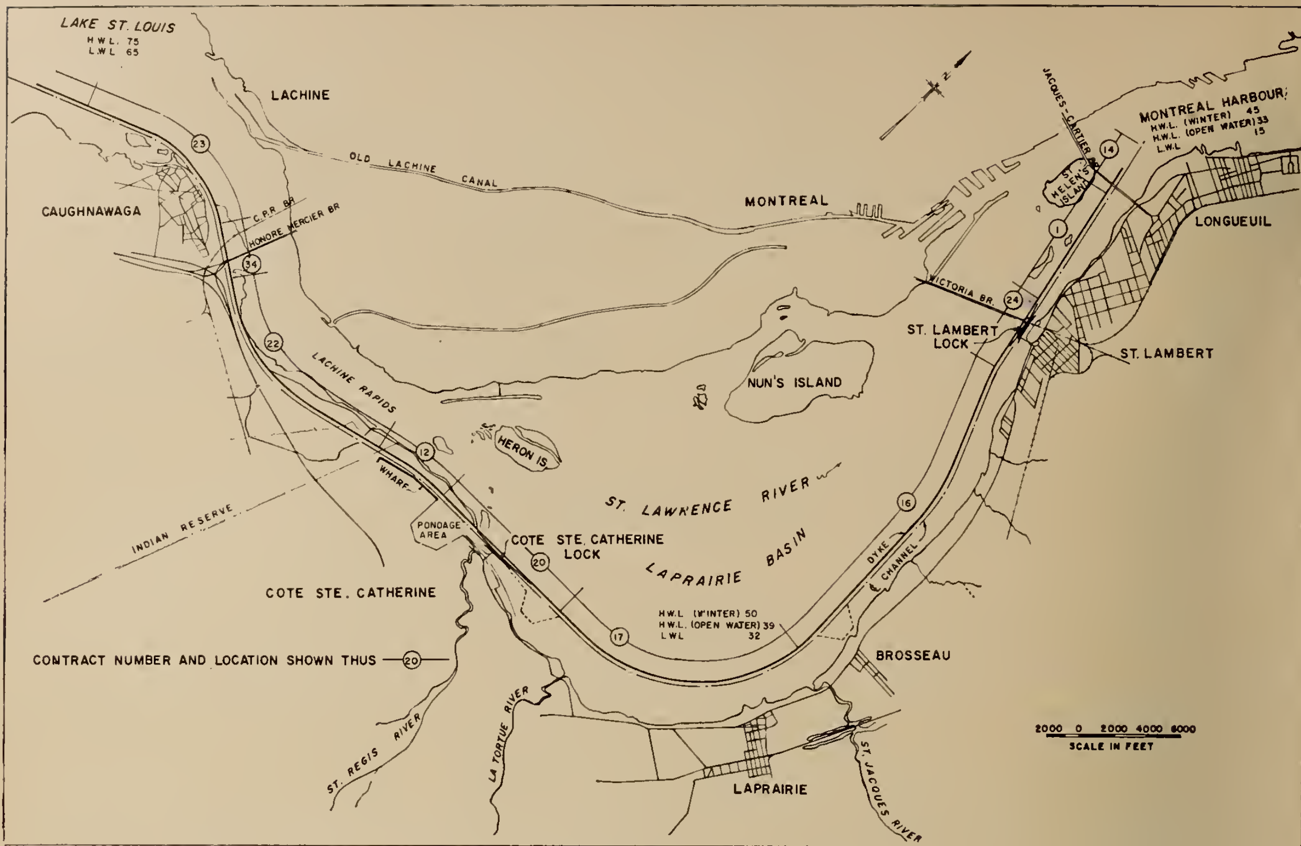


Fig. 1. General plan of the Lachine section.

Relocate highways (principally at bridge approaches).
Relocate and modify various power and communication lines.
Construct high level overhead extension to Honoré Mercier bridge.
Construct lift bridge for Canadian Pacific Railway.
Raise the C.P.R. approach embankments to provide an easier grade.
Construct a wharf at Côte Ste-Catherine.

Only a few brief general facts relating to the above works will be mentioned in this paper.

References to lock equipment will be omitted from this paper, except for brief facts relating to schedules.

Lock Locations

The best location for the lower lock was at the upstream side of Victoria bridge. This bridge carries highway as well as double track main line traffic of the Canadian National Railways. There were a number of advantages to this location, the principal ones being:

(1) A lift span for an 80-foot gap could be used at the lock, as compared to a 200-foot gap if the bridge crossed a canal reach.

(2) The bridge pier enlargement and lowering of the foundation was simplified when combined with the lock wall structure. Safety of the bridge piers during construction was assured.

(3) A dual lift bridge arrangement for uninterrupted highway traffic could be provided.

(4) Better control and dispatch of vessels since the bridge operates as a lock feature.

The best location for the upper lock was opposite the foot of the Lachine Rapids, or near the village of Côte Ste-Catherine. The final choice of location for this lock was entirely a matter of lowest overall cost, when considering the variations in excavation, concrete, and dyke construction quantities, and some variations in property affected.

Water Levels and Flows

Montreal Harbour has had a natural range of water level from 33 feet above mean sea level during the highest flood flow to 15 ft. at the extreme low flow. Ice jams cause winter water levels below Jacques Cartier bridge frequently to reach 40 ft., with a high recorded of about 45 ft. Lake St. Louis has a natural range of water level from 75 ft. to 65 ft., and is rarely affected by ice conditions. Laprairie Basin has a natural range of water level during open river conditions from 39 ft. to 32 ft., and has had occasional extremes during winter ice conditions of over 50 ft.

The locks have been designed to suit the extremes of water levels for Montreal and for Lake St. Louis, and for a regulated water level in the Laprairie Basin pool of 38 ft. It is probable that the locks will be operated initially with an intermediate pool level somewhere between 35 and 38 ft.

There is a drainage area of 180 square miles tributary to Laprairie Basin, largely made up of three small rivers: St. Jacques (63 sq. miles), La Tortue (57 sq. miles), and St. Regis (36 sq. miles) (Figure 2). A spring run-off from this area will normally be around 5,000 c.f.s., and it is estimated that the flow might reach 10,000 c.f.s. for a brief period of time.

The regulating works adjacent to St. Lambert Lock have been designed to discharge 10,000 c.f.s., with the pool level at 38 ft. The regulating works at Côte Ste-Catherine Lock have been designed to discharge 5,000 c.f.s. with normal Lake St. Louis level. This flow was adopted as an adequate amount to be discharged intermittently to keep Laprairie Basin channel fresh during summer low flow periods.

Dykes

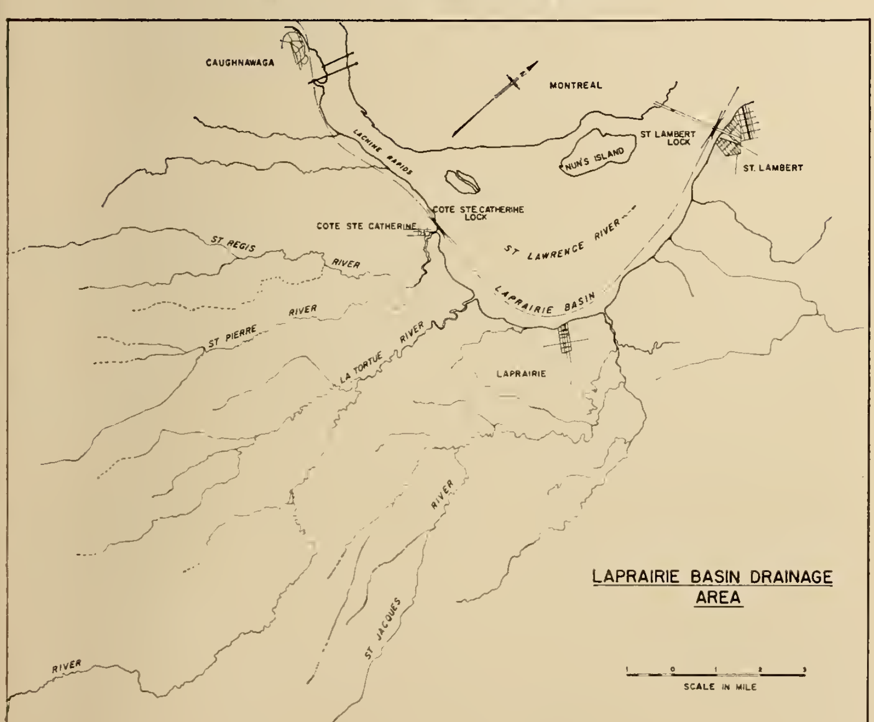
The dyke separating the canal from the river has a top width of 40 feet, and is continuous on the north side of the canal extending for the entire 18½ miles from Montreal Harbour to Lake St. Louis. There is also a 1½-mile section of dyke on the south side of the canal above Côte Ste-Catherine Lock. Typical dyke sections are shown in Figure 3. The top elevation of the dyke is 40 at the harbour entrance. From a location near Jacques Cartier bridge, a slope of 1 foot per thousand extends for a length of 18,000 feet until the top elevation becomes 58. This dyke elevation then extends uniformly for the remainder of the distance around Laprairie Basin. The slope from elev. 40 to 58 is roughly the same as the natural river slope between Victoria Bridge and Jacques Cartier Bridge, in which distance the river drops about 10 feet. Above Côte Ste-Catherine Lock the dyke has a uniform top elevation of 80.

The dyke below St. Lambert Lock will have a maximum head against it of only about 10 feet. The principal purpose of the large cross-section is to withstand the ice shoves from the river. The 8-mile dyke around Laprairie Basin has to serve two purposes. In normal operation the Seaway Canal water level will be a few feet higher than the river, but under winter ice conditions the river water level might be as much as 20 feet higher than the canal level for short periods of time. There is also the pressure from ice movements to be provided against. In all of the dyke construction around Laprairie Basin and below St. Lambert lock, the head on the dyke during the period of use as a cofferdam was greater than will occur during operating conditions. The highest and most important parts of the dyke work are along the two sides of the canal immediately above Côte Ste-Catherine lock. These dykes will have a maximum head against them of about 40 feet. Further details relating to dyke construction and the materials used will be found in paper by F. L. Peckover and T. G. Tustin, in this issue of *The Engineering Journal* (p. 69).

Channel Widths

The channel below the St. Lambert lock has a bottom width of 225 feet, which was considered to be the minimum for good operation where ships first enter the Seaway. The bottom width of the channel around Laprairie Basin was adopted at 300 feet, which provides an extra width of channel around the long curve. The decision as to the width of this part of the channel was also influenced by the necessity to have adequate materials of suitable types for dyke construction. Two turning basins have been provided in the Laprairie Basin reach. Above Côte Ste-Catherine lock there is a large pondage area for surge control, and beyond the pondage area a 4,000-foot wharf has been constructed. The channel is 280 feet wide at the wharf to provide ship clearance. From the Côte Ste-Catherine wharf to the canal entrance in Lake St. Louis the bottom width is 250 feet.

Fig. 2. Laprairie Basin drainage area.



Lock Dimensions

All of the Seaway locks have the same general dimensions, and these are essentially similar to those of the Welland Canal. The basic dimensions are: width 80 feet, usable length (fender to breast wall) 766 feet, and depth on the sill at low water level 30 feet. All locks have been designed so that a future twin lock at each site can be constructed without any serious interferences with ship movements.

St. Lambert Lock and Victoria Bridge (Fig. 4)

The lift at St. Lambert lock will vary from a maximum of 23 feet to a minimum of 5 feet depending on the water level in the harbour. The equipment for the lock and its arrangement is described by R. W. Willis, J. F. Pilon and J. E. Coke[1], The hydraulic design of the lock has been covered by D. McIntyre[2].

Victoria bridge crosses the lock immediately below the lower set of lock gates. Another bridge crosses the upstream end of the lock, just above the upper set of gates. Uninterrupted highway traffic will be maintained by the use of the alternate bridges.

The entrance walls are 2,950 feet long downstream and 2,300 feet upstream. They have been designed with a flare from the lock entrance of 1 in 10, and the flare has a length of 890 feet, to give a sufficient offset for a 75-foot beam vessel to lie alongside the parallel wall without hindering a vessel leaving from or entering into the lock.

Côte Ste-Catherine Lock (Fig. 5)

The lift will vary from 40 feet to 30 feet, depending on the water level of Lake St. Louis, and on the regulated level of the Laprairie Basin pool. The arrangement of equipment is generally similar to that at St. Lambert. A rolling lift bridge has been provided across the upper end of the lock for operating purposes.

The entrance walls are similar to those at St. Lambert, except that the angle of flare is 1:12, and the length of flare is 900 feet. The total lengths are 1,600 feet downstream and upstream.

Modifications to Canadian National Railway

No relocation has been required for the C.N.R., as the lift span has been constructed at the location of the old south span of the existing Victoria bridge. The modifications to the C.N.R. were almost entirely those connected with the excavation and construction of the lock structure under the bridge between pier 24 and the south abutment, and the erection of the new lift span.

After the Seaway Authority had decided on the dual bridge arrangement for uninterrupted highway traffic, the Canadian National Railways decided to proceed with a similar general arrangement to avoid any delays to railway traffic. The piers being constructed by the C.N.R. for the alternate railway route are seen in Fig. 6.

Modifications to Canadian Pacific Railway

The double track main line of the Canadian Pacific Railway near Caughnawaga now crosses the canal on two new single track lift bridges located about 75 feet east of the old railway embankment. The former tracks had a 0.75 per cent grade, which had to be eased to a 0.5 per cent grade as a compensation for placing a lift span in the line. The change of grade extended over 1½ miles and necessitated a track raising job of as much as 10 feet at the point of maximum raise.

Highway and Bridge Modifications

There have been no extensive highway changes other than the actual new approaches to the three bridges. The fact that a large part of the canal has been located in the river bed has minimized the effect on existing highways. One mile of new highway had to be constructed to replace the former highway at Côte Ste-Catherine, and one mile of highway had to be relocated to the east of the new Honoré Mercier bridge approach. Temporary diversions had to be provided during the construction of each of the bridges, and for a short distance along the canal.

The modifications to Jacques Cartier bridge required the raising of the structure south of St. Helen's Island by heights up to 40 feet, the enlargement of the piers, and the substitution of one through truss span in place of an existing deck span[3].

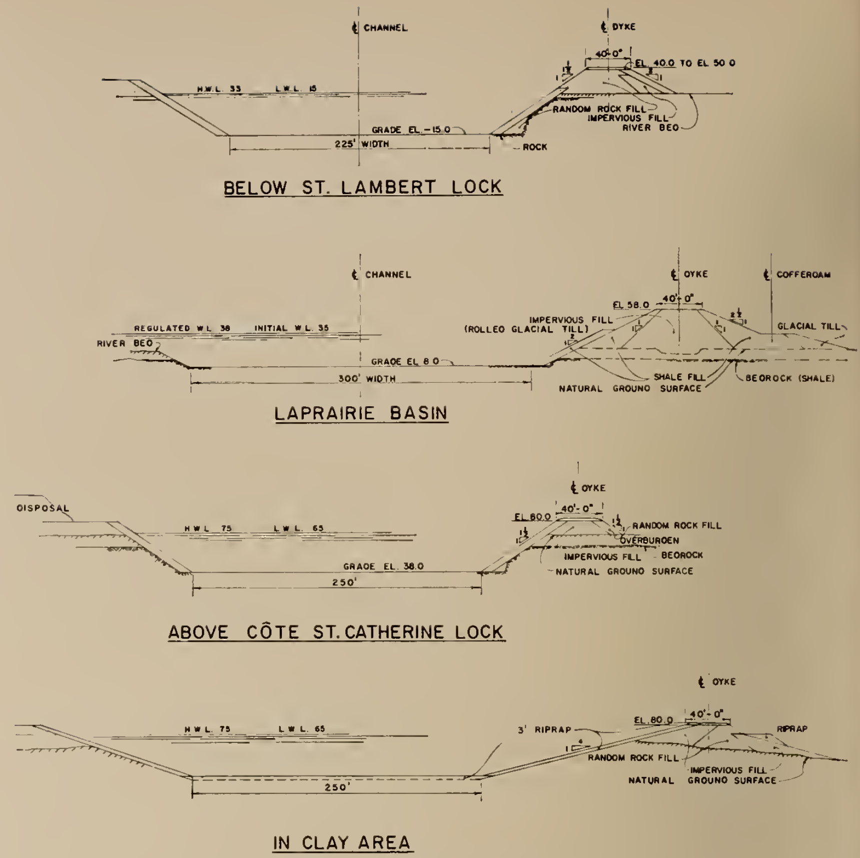


Fig. 3. Typical dyke sections.

The modifications to Victoria bridge approaches provide for the alternate use of either of the bridges across St. Lambert Lock.

The modifications to the Honoré Mercier bridge consist of a new extension to the south of the existing bridge. The old bridge had a descending ramp on the south side of the river, which has been demolished. The new extension has an ascending ramp (4.25%) to provide a high level crossing over the Seaway. South of the Seaway the new bridge provides for separate highway approaches to the east and to the west.

Municipal Services

Water intake and sewer discharge works have had to be constructed at a number of points along the canal to serve all of the affected municipalities.

Power and Communication Lines

A number of high voltage transmission lines and telephone lines have had to be relocated, and at each of the railway crossings extensive signal and telegraph lines were affected.

SCHEDULE FOR CONSTRUCTION

In June 1954, the final decisions were reached which permitted the power and navigation development of the International Section of the river to proceed. In July, the St. Lawrence Seaway Act was proclaimed, after which all of the Canadian Seaway construction was authorized to proceed.

In August 1954, it was agreed between Canada and the United States that the Seaway would be ready for deep draft traffic at the opening of navigation in the spring of 1959. Thus, just a little over four years were allowed for the final planning and constructing of the Seaway. It was appreciated that the schedules would be tight, and the engineers of the Seaway Authority had no choice but to fit the planning and constructing into the time available. All planning and all construction schedules have therefore been governed by the basic requirement that the Seaway would be ready to open in April 1959. The end date for completion of construction was fixed. Along with the preparation of the plans for the channels and structures was the general problem of splitting up the work into the most convenient contract units for construction, scheduling each contract, and fitting the contracts together as they reached completion.

A basic schedule to meet the completion date was prepared, from which a number of critical facts relating to the Lachine section became apparent:

(1) All major construction should be completed by the end of August 1958, in order to be able to complete all lock installations by October 1958.

(2) Three and a half years would be required for the general construction at the locks and for the installation of all the equipment.

(3) The Victoria bridge pier protection and lift span work could be done within three years.

(4) Three years would be required for the raising of Jacques Cartier bridge.

(5) Three construction seasons should be provided to complete the Laprairie Basin channel and construct the dyke. The closures at the local rivers could not be made before the summer of 1958.

(6) Two and a half years would be adequate for the work above Côte Ste-Catherine, including the lift bridges and other modifications to the Canadian Pacific Railway, and the extension of the Honoré Mercier bridge.

(7) A minimum of three months would be required at end of 1958 construction season for the opening of the canal at each end by dredging.

(8) All lock equipment contracts and contracts for steel for bridges should be awarded by early 1956.

Detailed schedules then had to be prepared for the locks, which would provide for building the structures, installing the equipment, and leave some time for testing. It was possible to gain about four months' time at each of the locks by arranging for the large river cofferdams to be constructed under separate contracts, during the time that the lock plans and specifications were being prepared. Detailed schedules were also prepared for all of the other work, which influenced the split up into the other eight canal contracts.

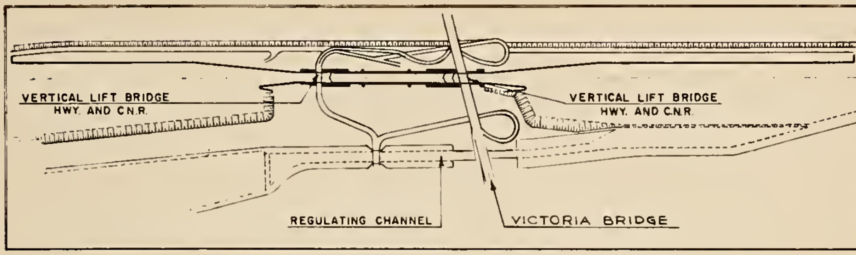


Fig. 4. St. Lambert lock.

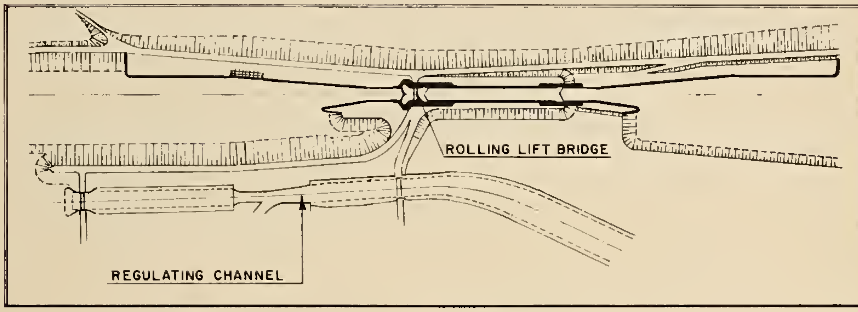


Fig. 5. Cote Ste-Catherine lock.

Every effort was made to inform the prospective contractors (when tendering) of the actual completion dates required, and of the necessity of meeting those dates. With the object of keeping a measure of control over progress, all contract specifications contained one or more intermediate dates, at which times certain phases of the work were required to have reached a certain state. These intermediate dates were in many cases not met, but they did prove very helpful in the continuous effort to keep all contracts up to a reasonable rate of progress. The intermediate dates were of particular importance where adjacent contracts were dependent one on the other. Each of the lock contracts had specified limiting dates for starting of concrete, and each one had a specified hourly output capacity of the concrete mixer plant. No attempt was made to specify contractors' equipment, but controls of contractors' rates of progress and general performances were written into the specifications of most of the contracts in several ways. These controls included:

(1) Specified early starting dates on certain parts of the work.

(2) Requirements that excavating equipment capable of a specified total rate of excavation be provided.

(3) Installation of a concrete mixer plant of stated minimum hourly output.

(4) Specified completion dates for various intermediate stages of the work.

Construction got under way in November 1954, by the awarding of Contract No. 1.

Fig. 6. General view of St. Lambert lock area and Victoria bridge, with Jacques Cartier bridge and Montreal Harbour in the background.

In a general way, 1954 and 1955 covered the basic planning. 1955 and 1956 were the heavy excavation years. Concrete work started in 1956 and was in full production during 1957. Installation of equipment and erection of bridges started in 1957 and has continued almost everywhere throughout most of 1958.

Many of the contracts have had very tight schedules, but it has been necessary to insist that these be closely adhered to in order to achieve the required Seaway completion date. In a number of instances contractors have claimed that the Seaway construction schedules have been too tight. The fact is quite apparent from the amount of work to be done in four years that the schedules could not have been otherwise than tight — and it was also apparent during the early period of construction that a few of the contractors did not take very seriously the schedule requirements set out in their contracts.

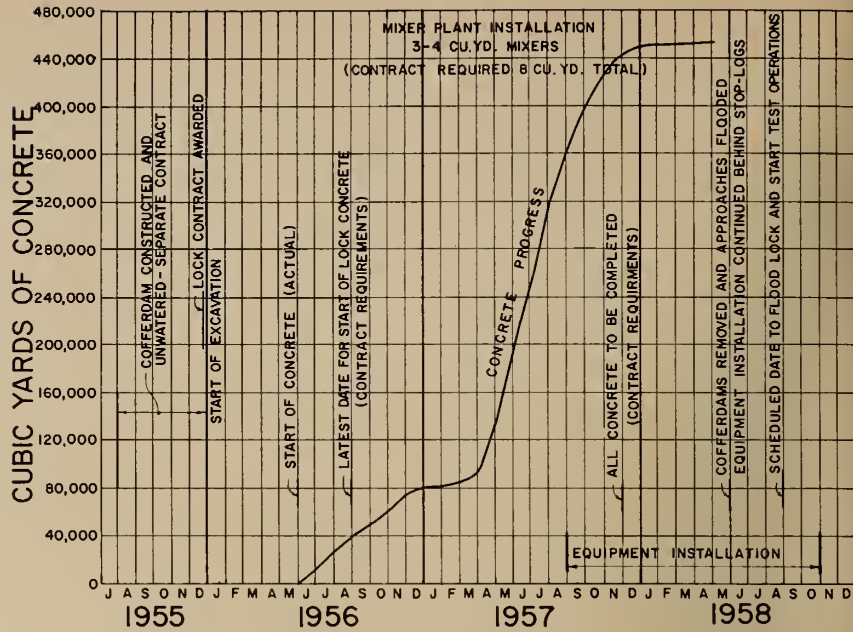


Fig. 7. Schedule and progress record, St. Lambert lock.

CONSTRUCTING THE CANAL

The first step towards construction was the splitting up of the 18.5 miles of work into reasonable size contracts, giving consideration to types of work, site limitations, acquisition of property, time for the preparation of plans, and overall schedule requirements. The contracts on which extensive subsequent work depended got early attention.

The next step was the setting of the sequence in which contracts would have to be awarded, so that the preparation of contract plans and specifications could proceed in the required order. Factors which influenced the sequence of contract advertising included designing time, minimum time which had to be provided for construction, acquisition of property, agreements with existing interests (provincial, municipalities, railways, transmission lines, etc.).

The 18.5 miles from Montreal Harbour to Lake St. Louis required the excavation of 18,000,000 cu. yd. of common material and 20,000,000 cu. yd. of rock (60% shale and 40% limestone with the line of separation mid-way through contract 12). The two locks required a total of 840,000 cu. yd. of concrete. The connecting dykes required 9,000,000 cu yd. of fill. In addition, a total of approximately 7,000,000 cu. yd. will have been excavated by dredging at the Montreal Harbour and Lake St. Louis entrances to the Seaway canal.

The canal and its two locks have been constructed in ten main contracts. Two of the ten main contracts covered the St. Lambert and Côte Ste-Catherine Locks with adjacent parts of the channel and dyke. The other eight contracts made up the remaining fifteen and a half miles of channel and dyke. It is noteworthy that three of these eight contracts were essentially completed well ahead of their schedules.

The ten main contracts, as awarded, have ranged in value from less than $1,500,000 to over $7,500,000. Channel and dyke contracts have ranged in size from less than 2,000,000 cu. yd. to 7,500,000 cu. yd., and these contracts have ranged in length from ¾ mile up to nearly four miles. Table I lists the ten contracts into which the construction of the 18.5-mile canal was divided. The following

Table I. Excavation and Dyke Summary

Contract No.	*Length of Channel* Miles	*Location*	*Award of Contract*	*Approximate Quantities* *Common Excavation* cu. yd.	*Rock Excavation* cu. yd.	*Dyke Construction* cu. yd.
14	0.9	Above Jacques Cartier Bridge to Harbour Entrance	June 1955	900,000	1,200,000	300,000
1	1.4	Below St. Lambert Lock to Jacques Cartier Bridge	October 1954	—	4,100,000	500,000
24	1.0	St. Lambert (1)	December 1955	—	2,500,000	—
16	3.8	St. Lambert to Laprairie	July 1955	4,800,000	2,300,000	3,200,000
17	3.0	Laprairie to Côte Ste-Catherine	July 1955	2,500,000	1,200,000	2,100,000
20	2.0	Côte Ste-Catherine (2)	September 1955	2,800,000	1,700,000	1,400,000
12	0.8	Côte Ste-Catherine	April 1955	400,000	1,300,000	—
22	2.7	Indian Reserve	November 1955	4,600,000	2,900,000	500,000
34	0.7	Honoré Mercier and C.P.R. Bridge Area	August 1956	800,000	800,000	50,000
23	2.2	Caughnawaga and Lake St. Louis Entrance	June 1956	1,200,000	2,000,000	600,000
	18.5		TOTAL:	18,000,000	20,000,000	9,000,000

NOTES: (1) Includes St. Lambert Lock. (2) Includes Côte Ste-Catherine Lock. (3) See contract locations in Figure 1.

are explanatory notes for the ten contracts, listed in chronological order as to date of award.

Contract 1

Contract I was planned to get work actually under way before the end of the 1954 construction season. The limits of the contract were set to keep entirely clear of any work at the Victoria bridge and Jacques Cartier bridge. (Up to that time no detail plans had been prepared for the work at either of these bridges.) Contract I covered a part of the channel which could have been adapted to a combined power and navigation scheme which Quebec Hydro engineers were studying, but about which no decision had been reached up to that time. It was particularly desirable to get at least one contract awarded and started in 1954 in order to establish many of the details and procedures which were necessary for contracting the work. A small amount of work, but not much more than a token, was actually done during the fall of 1954.

Contract 12

There were three reasons for selecting this contract as next to be awarded:

(1) Limestone rock to be excavated from this contract was one of the possible sources for concrete aggregates, and it was desirable to have an actual quarry size excavation in order to get full information on the suitability of this rock for concrete. (This rock was found to be unsuitable.)

(2) Limestone rock from this area was required for the riprap on the dyke of contract 1.

(3) It had been decided to use rock and common material excavated under this contract for the construction of the initial stage of the large cofferdam in Laprairie Basin for Côte Ste-Catherine lock.

The upper limit of this contract had to be kept clear of the Caughnawaga Indian Reservation as no rights had been obtained from the Reserve up to that time.

Contract 14

This contract included the downstream end of the canal, adjacent to the dredging contract at the Montreal Harbour approach. Included in this contract was the channel excavation forming the first cut for the enlargement of piers 9 and 10 at Jacques Cartier bridge. See Fig. 15 (stage one first cut). By this time, the general plans had been worked out for the raising of Jacques Cartier bridge, the scheduling for which required a very early start.

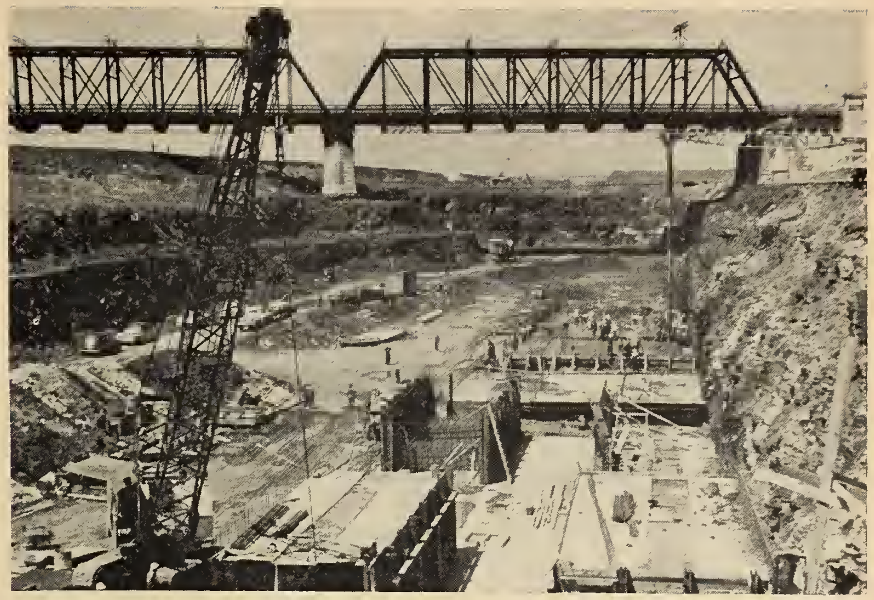


Fig. 8. Initial construction at St. Lambert lock with first stage of excavation at Victoria bridge piers.

Fig. 9. St. Lambert lock construction essentially completed. No change in Victoria bridge.

Contracts 16 and 17

These two contracts cover seven of the eight miles of the channel excavation and dyke construction around Laprairie Basin. With the large cofferdams to build, and with the large volume of excavation and dyke construction, it was apparent that this work would have to extend through from 1955 to 1958. On account of the 20-foot rise of water level due to ice jams, it was not planned that work would continue through the winters. It was therefore essential to get these contracts going early so that advantage could be taken of a part of the summer of 1955 to get the first cofferdams built and the procedures of excavation and dyke construction established. These two contracts were advertised on the same date.

Included in contract 16 was the complete construction of a high cofferdam for the St. Lambert Lock, and also its unwatering.

Included in contract 17 were the closures of the river gaps in the summer of 1958. Also included in this contract were extensions to the Laprairie water intake pipe and sewer discharge.

Contract 20

This contract included Côte Ste-Catherine Lock and about one mile of the channel and dyke construction. This lock contract was awarded in advance of the St. Lambert lock because this lock structure was independent of any existing railway or highway facilities, and it was more practical to complete these plans and specifications quickly than those for St. Lambert.

Contract 22

This is the largest volume excavation contract of the Lachine section, and of the whole Canadian Seaway. It included three miles of deep channel, a relatively low dyke, and was located entirely within the Indian Reservation land. Both from the point of view of the large quantities of excavation involved, and the problems which might arise from the expropriation of lands, this contract came next in sequence. This contract had 2,000 feet of canal to be excavated through soft clay.

Contract 24

This contract included St. Lambert lock and the substructure for the lift span at Victoria bridge. It also included modifications to the St. Lambert water intake. This was one of the most congested areas of the whole Seaway. With the many railway, highway, communications and municipal problems, it would have been desirable to have started this contract earlier. However, it had been impossible to complete the general layout and prepare the plans earlier. This lock has the largest volume of concrete of any of the five Canadian locks. A very stiff construction schedule had to be specified when advertising the work, so that the contractors tendering could properly appreciate the problems to be met.

Contract 23

This contract included the most difficult cofferdams of the Lachine section, which had to be constructed in fast and deep water along the shore of the village of Caughnawaga.

Contract 34

This was the last of the ten main contracts to be awarded for the canal in the Lachine section. It was only ¾ of a mile in length but it included all of the work relating to the C.P.R. embankment widening and the substructure for the new C.P.R. bridge. It also included some of the work relating to the extension to the Honoré Mercier bridge. Large quantities of the excavated rock were used for railway and highway embankments. This contract was quite complicated in its schedule requirements, as parts of the work were dependent on the diversions of railway and highway traffic on to the new bridges.

Other Contracts

Separate contracts were let covering features other than the actual canal. Among the larger features included in separate contracts were the following:

- Enlargement of Jacques Cartier bridge piers.
- Raising the bridge and erecting the new channel span.
- Victoria bridge lift spans (two).
- Regulating works at St. Lambert.
- South shore collector sewer.
- Water intake at Longueuil.
- Côte Ste-Catherine wharf.

Fig. 10. St. Lambert lock completed. Victoria bridge lift span being erected.

- Honoré Mercier bridge substructure.
- Honoré Mercier bridge superstructure.
- Canadian Pacific Railway lift bridges.
- Highway paving.

Further references to these features will be confined to any direct effects on the construction of the actual canal.

PROBLEMS OF CONSTRUCTION

The main problem of construction was the very large volume of work to be done within the tight schedule limits. Another construction problem of great importance was the co-ordin-

Fig. 11. General view of construction of Cote Ste-Catherine lock.

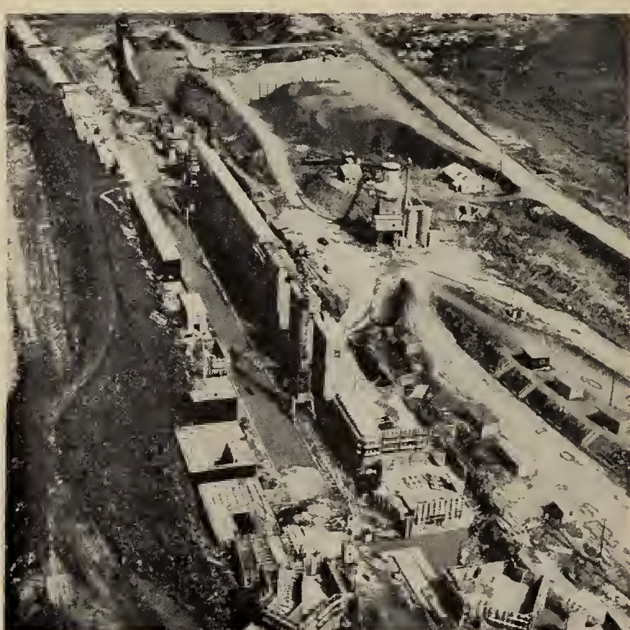
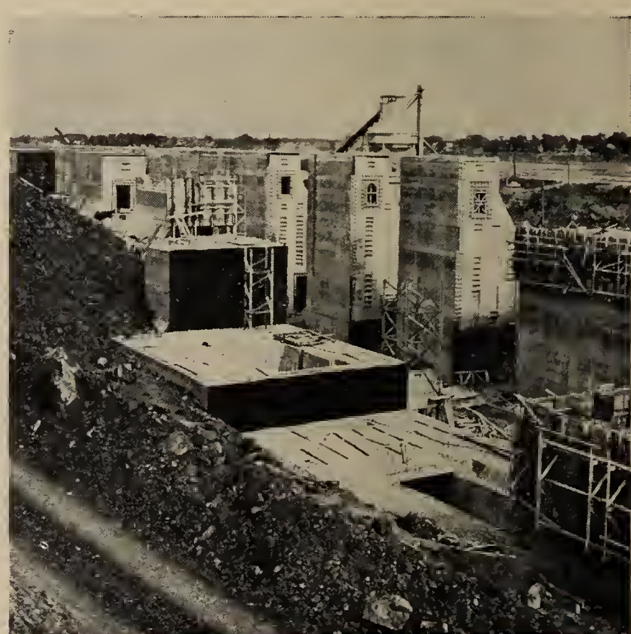


Fig. 12. Cote Ste-Catherine lock, showing monolith construction.



ation of the work of the many contractors, and the co-ordination of construction with the maintenance of all existing services (railways, highway traffic, power and communication lines, water supply and sewers, etc.). These were largely problems for the Seaway Authority to solve in the split-up of the work into contracts, and in the general planning of the work.

Some of the problems relating to the actual construction methods and procedures are described hereunder.

St. Lambert Lock

The lock is located in the former bed of the river, and the first step was the construction of a large cofferdam to unwater an area of about 150 acres. This cofferdam has a length of approximately one mile parallel to the river with connections to the shore at each end. The part parallel to the river was constructed to the full section and quality required for the permanent dyke of which it later became a part. The upstream shore connection was of similar construction. The downstream shore connection was somewhat of a lighter construction as no ice shoves were possible. As the schedule of lock construction required uninterrupted work throughout two winters, it was necessary to construct the cofferdam to an elevation which would make it safe against overtopping by floods caused by ice jams. This cofferdam was therefore constructed to elevation 49, to take a 20-foot rise of water level.

It was necessary to get the construction of the lock underway during the winter of 1956, and in order to be sure of completing the cofferdam during the fall of 1955, this part of the work was included in contract 16. In the following table are shown a few of the schedule dates and some approximate actual dates for the complete construction of the St. Lambert lock.

These dates show a brief record of the performance, which terminated in a satisfactory manner.

July 8, 1955	Contract 16 awarded for four miles of channel and dyke, which included the cofferdam for the lock.
Dec. 1955	Cofferdam for lock completed.
Dec. 23, 1955	Lock contract awarded.
Jan. 1956	Start of excavation
June 1956	Start of placing concrete (almost three months ahead of the date required by contract).
Sept. 1957	Start of equipment installation.
Nov. 1957	Concrete essentially completed.
Sept. 1958	Equipment installation essentially completed.

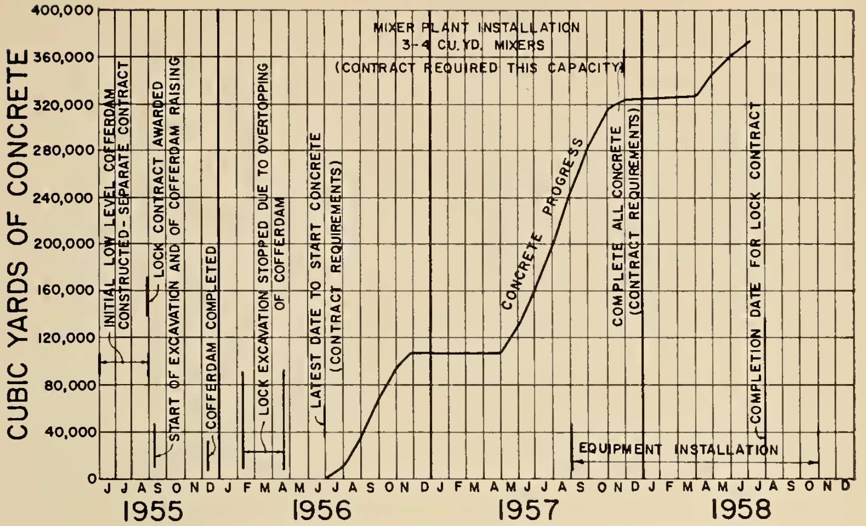


Fig. 13. Schedule and progress record, Cote Ste-Catherine lock.

Figure 6 shows the lock, nearing completion. Figure 7 is the general progress record for the work, and shows the periods of time for cofferdam construction, for the construction of the lock and entrance walls structures, and for the installation of equipment.

The whole cofferdam was constructed in advance of the awarding of the lock contract and was turned over to the lock contractor in an unwatered condition, ready for the start of excavation. The total construction time available to the main contractor was 32 months (January 1956 to August 1958).

All blasting had to be conducted under very strict regulations, particularly as the excavation approached close to and under Victoria bridge. Highway traffic on the bridge, (up to 2,000 cars per hour), had to be interrupted for every blast.

According to specifications, the contractor was allowed eight months in which to advance the excavation and get started on concrete. Concrete placing actually started three months earlier than had been required, but did not progress at an adequate rate in 1956 to meet the schedule. Note the excellent production performance by the contractor during 1957, reaching a peak rate of over 70,000 cu. yd. per month.

The construction procedure for the strengthening and enlarging of pier 24 and the south abutment of Victoria bridge was one of the most critical problems of the job. The piers of this bridge are stone masonry and were constructed over 90 years ago, and are founded on shale. It was necessary to take extreme precautions to avoid any damage to the foundations during the period of excavation for the lock and construction of the enlargement of the piers. The excavation for the lock required going about 40 feet below the elevation of the river bottom shale on which the piers were founded. The first operation was the excavation of a 100-foot wide cut to grade for a distance of over 200 feet along the centreline of the lock under the bridge. The next step was the excavation of a lateral trench in shale to grade through to the abutment on the one side of the lock and to pier 24 on the other side of the lock. A 12-foot section of the lock structure was then constructed against the rock underlying pier 24, and similarly for the south abutment. In a series of seven steps the shale was excavated up to the backline of the concrete in 12-foot trenches, and was followed after each excavation step by the construction of another 12-foot block of concrete. The whole operation of constructing the portion of the lock about 100 feet along pier 24 and along the south abutment required a total time of almost one year. It was not until this portion of the lock had been completed and had made the bridge piers completely safe that any change was made in the steel work. All during the time of the above work, railway and highway traffic passed over the bridge without interruption, except during blasting.

Figures 8, 9, and 10 show the first step, the concrete lock work completed, and the bridge almost erected.

Côte Ste-Catherine Lock

This lock is also located in the former bed of the river and the first step had to be the construction of a large cofferdam to unwater the area. The initial part of the cofferdam (up to elevation 40) was constructed under a separate contract. This initial low cofferdam was turned over to the lock contractor ready to set up pumps and start unwatering. This procedure saved about four months in time for the lock construction. The first obligation of the lock contractor, as provided for in the specifications, was to unwater the initial cofferdam and to immediately proceed with the raising of it to at least elev. 50 which was considered to be an adequately safe height to protect the work against high water level conditions in the winter due to ice jams. Extremely severe conditions did occur during the winter 1955-56, and in early February a large amount of the ice which had formed in Lake St. Louis broke away and formed an ice jam at the upper end of Laprairie Basin, which created water level conditions at the lock site higher than any which had previously been recorded. The cofferdam was overtopped and approximately two months of time was lost before the cofferdam could be again unwatered and excavation proceed.

The total construction time available to the main contractor was 34 months (October 1955 to July 1958).

The following tabulation shows an outline of the schedule and a record of the performance.

May 1955	Contract 12 awarded for ¾ mile of channel to the west of Côte Ste-Catherine lock, which included the initial cofferdam for the lock.
Aug. 1955	Initial cofferdam for the lock completed.
Sept. 1955	Lock contract awarded.
July 1956	Start of placing concrete (exactly on the date required by the contract, in spite of having lost two months by the cofferdam being overtopped).
Sept. 1956	Start of equipment installation.
June 1958	Concrete essentially completed.
Oct. 1958	Equipment installation essentially completed.

Figure 11 is a general view of the lock under construction and Fig. 12 shows an enlarged view of typical lock wall arrangement and methods of construction. Figure 13 shows the general progress for the work and shows the periods of time for initial cofferdam construction, the time during which the cofferdam was flooded, the construction of the lock and entrance walls structures, and the installation of equipment.

This contractor had a mixer plant installation of three 2-cu. yd. mixers, only half the capacity of that at St. Lambert.

Victoria Bridge Lift Span

The modifications to Victoria bridge required the installation of a lift span in place of the old 250-foot truss span. The construction of a lift span for Victoria bridge had been planned and estimated by C.N.R. engineers for earlier north shore layouts for the Seaway, and the general procedures had been pretty well worked out.

In October 1957, highway traffic was diverted completely off the last two spans of the bridge on to a road along the dyke and thence to the south shore across temporary structures (See Fig. 6).

The highway will not be restored on to Victoria bridge until the lift span has been completely erected. Superstructure erection was tied in very closely with train movements, and many interruptions were necessary. The procedure for the removal of the old structure and the replacement of the new railway lift span can be briefly described in the following steps:

(1) Construction of falsework across the lock and the loads of the old railway floor system transferred to the falsework.

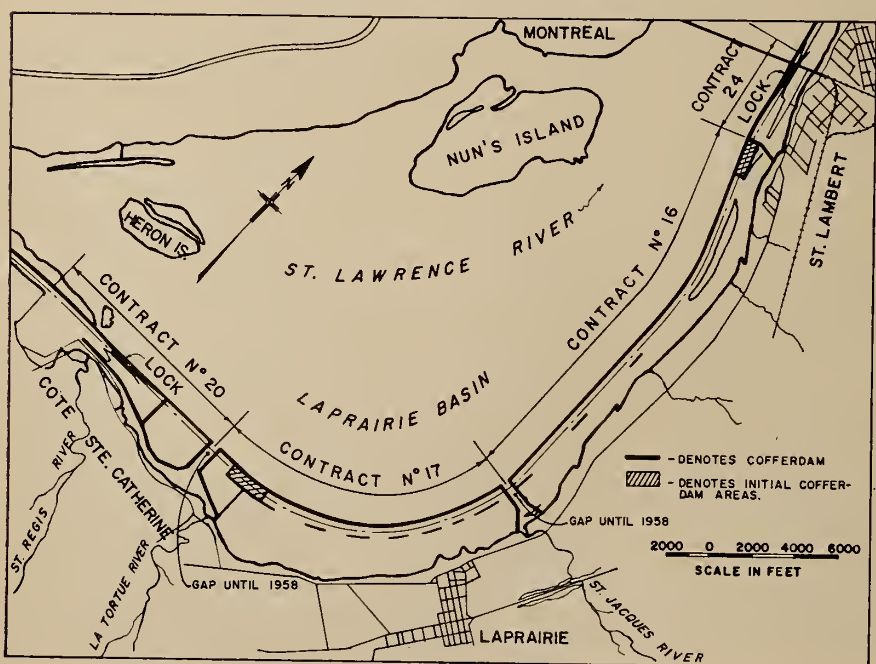
(2) Demolition of the old trusses and the old highway brackets.

(3) Construction of pier seats for the new lift span girders.

(4) With a short complete railway interruption, and with the floor system cut apart for the two tracks, the old floor system and falsework for one track was removed and a new plate girder span placed.

(5) Second new girder span placed in the same manner.

Fig. 14. Plan of cofferdams, Laprairie Basin.



Laprairie Basin Channel Excavation and Dyke

It is roughly 8 miles from St. Lambert lock to Côte Ste-Catherine lock, and all of this part of the channel has been located in the former bed of the river. Figure 14 shows the limits of the two Laprairie Basin contracts and the two locks. This figure shows the cofferdams for contracts 16 and 17, and also shows the gaps separating the contracts, providing for the flows of the local rivers until they could be taken down the Seaway channel and through the St. Lambert regulating works to the lower channel and thence to the St. Lawrence River at Longueuil. The closures at the gaps were made in the summer of 1958, after the spring run-off. This location around Laprairie Basin required large cofferdams, which were designed to be incorporated into the finished dyke. The quantities of excavation here were roughly double the quantities required for dyke construction, and made possible a reasonable amount of selection of materials. Excess excavation went to reclaim low land along the shore.

The contract plans suggested that the construction should be done by

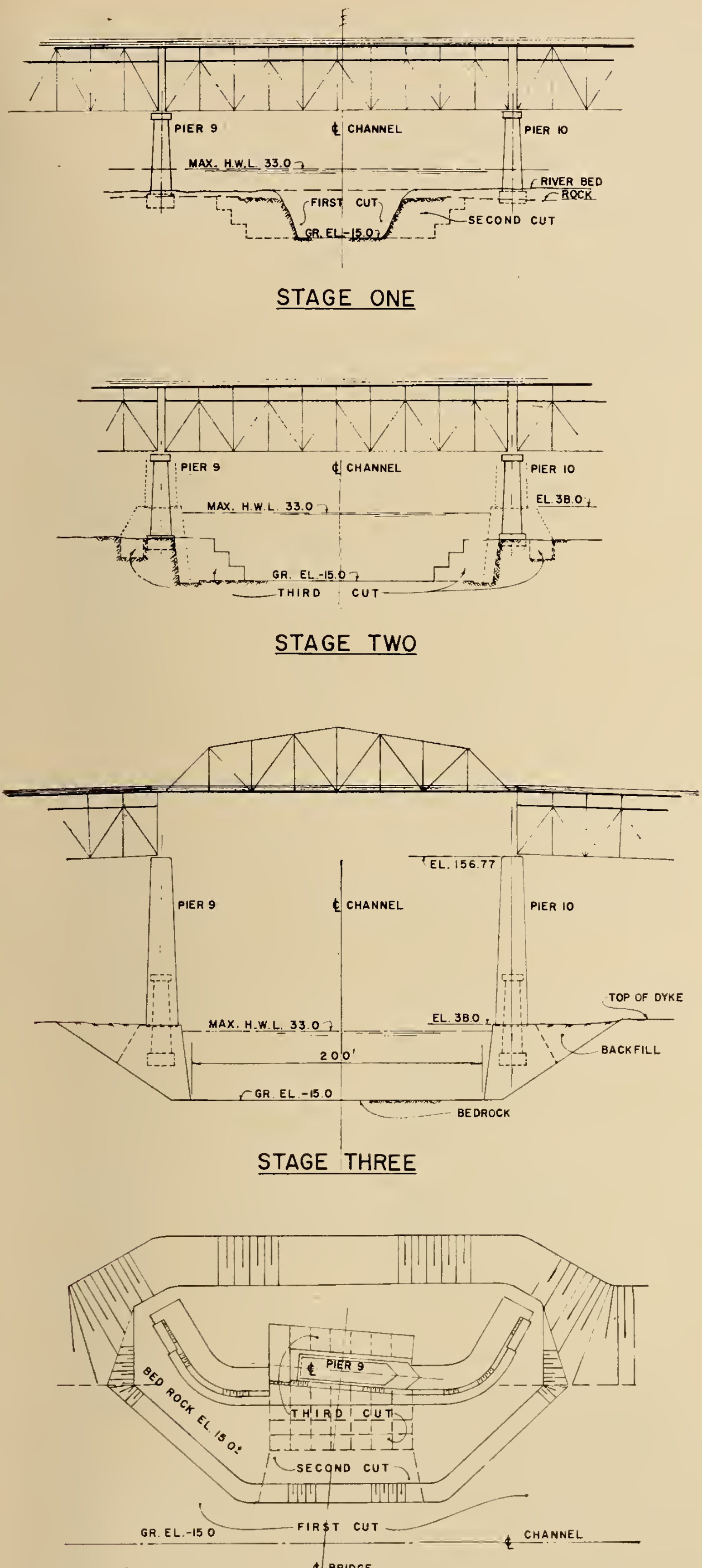


Fig. 15. Jacques Cartier bridge, pier enlargement and channel excavation.

the initial construction of a cofferdam around a convenient area with materials brought in from adjacent areas. When the first area was unwatered, it would provide large quantities of fill material for extending the cofferdams. The contractors for 16 and 17 both adopted this procedure. Figure 14 also shows the initial cofferdams constructed by the contractors.

The St-Jacques, La Tortue, and St-Régis Rivers have a normal spring run-off of as much as 2,000 c.f.s. each, but become almost dry during most of the summer months. The construction planning had to provide for the unrestricted flow of these rivers until the summer of 1958.

As the Laprairie dyke work was planned to have construction start in 1955 and as the work would extend through parts of four seasons, the general design of the channel and dyke construction and the contractor's operations had to be planned to handle the flows of these three rivers. As a result, this part of the channel and dyke was split into three separate contracts with specified gaps left at two points between the contracts. Three separate sections of the channel and dyke could be completed independently with the closures at the two gaps made in 1958 after the spring run-off had occurred. This plan has been followed.

In order to provide for the flows of these rivers regardless of what the discharge might be, the general schedule required the completion of the St. Lambert regulating works and the opening up of all the cofferdams below St. Lambert lock not later than early spring of 1958. The general schedule also required the portion of the Laprairie Basin channel and dyke from St. Lambert to Laprairie to be completed by the end of 1957 season, thus the flow of the St. Jacques River could be diverted into the completed channel downstream of Laprairie and flow through to the St. Lawrence River at Montreal. A small cofferdam was required across the upper end of the completed channel to permit the completion of the excavation and the closure of the gap in the dyke where the two contracts had been separated (see Fig. 16).

The following tabulation shows an outline of the schedule and a record of the performance.

July 1955	Contracts 16 and 17 awarded.
Oct. 1955	Initial cofferdam of contract 16 completed.
Nov. 1955	Initial cofferdam of contract 17 completed

Dec. 1955	St. Lambert lock high level cofferdam completed by contract 16.
Oct. 1956	All cofferdams completed contract 16.
June 1957	All cofferdams completed contract 17, (except closures at gaps).
May 1958	Channel and dyke completed between St. Lambert and Laprairie (contract 16).
June-July 1958	St. Jacques River gap (between contracts 16 and 17) closed, and channel and dyke completed.
July-Aug. 1958	St-Regis — La Tortue River gap (between contracts 17 and 20) closed, and channel and dyke completed.
Aug. 1958	Channel and dyke completed between Laprairie and Côte Ste-Catherine.

The actual time of construction for the 8-mile section channel and dyke was three years, or an actual working time of about 24 months for 12,000,000 cu. yd. of excavation — an average of 500,000 cu. yd./month.

Jacques Cartier Bridge—Enlargement of Piers 9 and 10

The modification work at Jacques Cartier bridge had to be one of the first jobs to get started due to the slow, step by step, program which had to be followed. The only phase of bridge work which will be covered in this paper will be the excavation of the Seaway channel between piers 9 and 10, and the strengthening and enlarging of the foundations of these two piers. Figures 15 and 17 indicate the problem of excavating the 200-foot channel between piers 9 and 10 to a depth of about 30 feet below the original shale foundation.

The initial channel cut 60 feet wide midway between piers 9 and 10 was included in contract 14, and was made during August and September 1955. The step by step channel widening and pier base enlargements started in late 1955 and took most of the 1956 construction season. In this work all precautions were taken to avoid any disturbance to the shale underlying the piers. The first step of this contract was to excavate a 15-foot wide trench laterally from the first excavated channel into the face of the pier on each side. A 12-foot section of the concrete for extending the pier downward was then placed and subsequent steps of a 12-foot excavated trench and a 12-foot addition to the new concrete of the pier completed the new piers in seven steps. The whole operation of the enlargement and strengthening of piers 9 and 10 extended over a period of twelve months, all of which was scheduled for completion and was completed before the start on the erection of the new truss.

The progress record for the work at Jacques Cartier bridge is summarized hereunder:

May 1955	Contract 14 awarded (included initial channel excavation cut at bridge).
Sept. 1955	Initial channel cut completed.
Sept. 1955	Contract awarded for pier enlargements.
July 1956	Contract awarded for bridge raising.
Oct. 1956	Channel completed to full width at bridge and bases for piers 9 and 10 enlarged.
Oct. 1957	New through truss span between piers 9 and 10 completed.
July 1958	Bridge raising completed.

Fig. 16. General view of canal from Laprairie looking north. Victoria and Jacques Cartier bridges in the distance; Laprairie turning basin in the foreground.

Honoré Mercier Bridge Extension

In relation to scheduling, it was necessary to have highway traffic entirely diverted to the new bridge not later than July 31, 1958, in order to permit the removal of the rockfill which had been constructed across the Seaway channel to provide for the temporary diversion of the highway traffic. The temporary highway diversion was constructed during the period from September 1956 to February 1957, immediately after which the old south approach ramp was demolished. Highway traffic remained on the diversion from February 1957 to July 1958, (see Fig. 18).

Canadian Pacific Railway Relocation

Before starting to raise the track, the shoulders of the existing embankment had been widened using rockfill from the canal excavations. In addition to the C.P.R. work, about a half mile of New York Central track which joins the C.P.R. at Adirondack Junction had to be raised. The track raising and relocation work required about 500,000 cu. yd. of rockfill, plus about 200,000 cu. yd. of crushed stone ballast.

The procedure of construction consisted of the excavation of the channel east of the railway embankment up to the site of the new bridge. In the planning of the relocation with the C.P.R. engineers the bridge was located as close to the embankment as possible without affecting the safety of the embankment. The piers for the new bridge were constructed during the period April to September 1957 and the erection of the superstructure followed. The railway traffic was diverted on to the bridge on June 5, 1958, and excavation of the old embankment followed immediately thereafter, (see Fig. 19).

Track raising work was done by railway forces and equipment. Four months were required to complete the jacking and ballasting, after the initial widening with heavy rockfill had been completed.

Notes on Cofferdams

Thirteen miles of the channel has been constructed in the former bed of the river and the construction of the cofferdams has been a large item of cost. Of the ten contracts, only the three extending from above Côte Ste.-Catherine lock to just beyond the C.P.R. embankment were constructed on land. The six contracts below Côte Ste.-Catherine were entirely constructed in the bed of the river. The upstream contract covering 2¼ miles along the river at Caughnawaga required large cofferdams constructed in fast water, for which two-thirds consisted of rockfilled timber cribs with steel sheet piling.

The remainder of the cofferdams throughout the work were of fill, generally obtained from the excavations.

A portion of the fill cofferdam at the extreme downstream limit stretching into deep water at Montreal Harbour required steel sheet piling driven through the fill to obtain adequate water tightness where the head exceeded about 10 feet.

The total cost of cofferdams and unwatering for the whole canal was of the order of $5,000,000, of which about $3,000,000 represents the cofferdams for the contract at Caughnawaga, and $1,000,000 represents the cofferdams and unwatering for all of the Laprairie Basin work.

Fig. 17. Jacques Cartier bridge. Third stage of channel excavation with three steps of concrete completed at pier 9.

Winter Conditions—Ice Jams and High Water Levels

The St. Lawrence River at Montreal has always been subject to ice jams and consequent flood conditions. Records for the past 50 years were available and the construction schedule for all of the work of the Lachine section had to be related to the probable winter conditions.

Contracts 14, 1, 16, and 17 which included only excavation of the channel and construction of dyke, were scheduled on the basis that low level cofferdams would be all that would be required, i.e. the contractors on these parts of the work would have to provide enough equipment to do the work within the non-winter months available to them. It was also planned that in these four contracts, suitable arrangements would be made for flooding the work prior to high water conditions in order to avoid large volumes of erosion which could occur if they were overtopped. In one case the cofferdam was overtopped in early January as a result of trying to take advantage of a late ice build-up. When the ice jam and flood did come, there was insufficient time left to control the flooding of the cofferdam, and about 10,000 cu. yd. of material eroded into the channel and subsequently had to be re-excavated.

The construction of the St. Lambert and Côte Ste.-Catherine locks required the entire time available, and it was therefore necessary to plan on high level cofferdams adequate to cope with expected ice conditions. The specified minimum cofferdam elevation for Côte Ste-Catherine proved inadequate and the Côte Ste-Catherine cofferdam was overtopped. The winter conditions of 1955-56 were substantially more severe than any previous known occurrence. The consequence of this overtopping was to interrupt the excavation and to delay the start of concrete by about two months.

The two contracts covering the seven miles of channel excavation and dyke construction around Laprairie Basin were planned on the basis that the cofferdams would be flooded early in the winter. The contractor who had the 4-mile section from St. Lambert to Laprairie (contract 16) elected to construct a high cofferdam and continue work throughout the winter. During the winter of 1956-57, there was a period of several weeks when water level was within a foot or so of the top of the cofferdam, but no overtopping occurred and work did proceed all winter. The cofferdam

Fig. 18. Honore Mercier bridge crossing of canal. Remainder of temporary rock-fill for highway diversion in foreground.

Fig. 19. Canadian Pacific Railway twin lift bridges, Caughnawaga. This railway crosses alongside the Honore Mercier bridge.

for contract 16 was further strengthened and raised before the winter of 1957-58, and was never in any danger of being overtopped. Unfortunately, the work was stopped for three months by being flooded out due to very heavy thaws in December and again in March, causing large surface run-off.

Filling the Canal

The filling of the canal at the end of construction presented a few small problems. This operation was naturally separated into three distinct areas:

(1) The section below St. Lambert lock was flooded to equalize the water level with that existing in Montreal Harbour, after which the remainder of the cofferdam below Jacques Cartier bridge was removed. The final cleanup at that barrier is now being done under a dredging contract. Three weeks were taken to fill this area.

(2) The Laprairie Basin section extending from St. Lambert lock to Côte Ste-Catherine lock required the diversion of the three local rivers into the channels downstream for the completion of the work at the gaps which had originally been left for their flow. The initial filling of this part of the canal up to Montreal Harbour water level (actually slightly higher to allow for slope) was the first step to permit the local run-off to flow through the regulating works to the harbour. The final filling of this section of the canal to operating water level will be done by passing water through the Côte Ste-Catherine regulating works to fill the intermediate pool.

(3) The section above Côte Ste-Catherine lock extending up to Caughnawaga required complete filling to Lake St. Louis level before the cofferdam at the upstream end could be removed. This required an inflow of 1,000 c.f.s. per day for five days.

After equalizing water level in the canal with Lake St. Louis, the upstream cofferdam was removed, and the remainder of the channel excavation will be done by dredging.

Lowering of Ground Water

Along the 13 miles of the south shore roughly from the town of Preville (or a mile above Victoria bridge) to the upper limits of the Village of Caughnawaga, there are several hundred residences and a few schools and other occupied buildings. Many of these homes depended on wells for their water supply.

The construction of cofferdams around Laprairie Basin, and particularly the excavation into the shale underlying the glacial till, had the effect of lowering the ground water around the shore of Laprairie Basin with the consequence that several hundred wells were dried up. Studies and estimates were made of various means of supplying the residents, the final conclusion being that for assurance of water supply during summer or winter, delivery by tank trucks into 250-gallon tanks furnished by the Authority to individual residents was the most satisfactory way of meeting the situation. With the Seaway channel located such a distance out from shore, it was not expected that the wells in this area would run dry, and the two contracts did not make any provision for the local water supply.

Around the shoreline in the Village of Caughnawaga, the Seaway channel is entirely in rock and close to the shore. It was expected that wells in this area would run dry and the construction contract provided for the supply of water to local residents. As it turned out, the wells in Caughnawaga did not run dry and there was no problem.

CONCLUSION

During 1955 and early in 1956 there was scattered excavation under way in many parts of the 18.5 miles of Seaway route. By 1957, the excavations were mostly joined up. 1958 has seen completion of all channels and dykes, and the start of permanent flooding. Dredging at the Montreal Harbour and Lake St. Louis entrances is in progress.

Most of the problems that have been encountered in the construction of this part of the Seaway are those which would be encountered in hydro-electric projects, municipal works, and transportation construction, but the area covered by the whole project caused many of the problems, as far as quantities were concerned, to be big ones. There were few new problems encountered, except those relating to a large number of contracts fitted into a tight over-all schedule.

Construction of the Seaway was nearing completion by August, and progress in general had been reasonably close to the planned schedules. Three of the ten main canal contracts were completed ahead of schedule, and the other seven have been completed essentially on schedule or certainly within the permissible tolerance.

The completion of the work essentially within the four years available can be taken as showing successful planning and excellent performance on the part of the contractors.

References

1. R. W. Willis, J. F. Pilon, and J. E. Coke. *The Engineering Journal,* 1957, October, p. 1425.
2. D. McIntyre. Ibid., 1956, Sep., p. 1154.
3. R. Chamberlain. Modifications to the Jacques Cartier Bridge. To be published in *The Engineering Journal,* December 1958.

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have added one-third of one per cent to this amount. The total expenditure on soil and foundation work has therefore been little more than one half of one per cent of that on the related construction.

ACKNOWLEDGMENTS

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REFERENCES

1. Collin, A., Landslides in Clay (1846); translated by W. R. Schriever, Univ. of Toronto Press, Toronto, 1956.
2. Peckover, F. L., The St. Lawrence Seaway: Considerations in Channel Excavation; **Can. Min. and Met. Bull.**, 1957, vol. 60, pp. 184-188.
3. Eden, W. J., and Hamilton, J. J., The Use of a Field Vane Apparatus in Sensitive Clay; Publication No. 4490, National Research Council, Ottawa, 1957.
4. MacClintock, P., Glacial Geology of the St. Lawrence Seaway and Power Projects; New York State Museum and Science Service, Albany, 1958.
5. Clark, T. H., Montreal Area, Laval and Lachine Map Areas; Geol. Report 46, Dept. of Mines, Quebec, 1952.
6. Wilson, A. E., Geology of the Ottawa-St. Lawrence Lowland, Ontario and Quebec; Geol. Surv. of Can., Mem. 241, Ottawa, 1946.
7. Terzaghi, K. and Peck, R. B., Soil Mechanics in Engineering Practice, John Wiley and Sons, Ltd., New York, 1948, pp. 423, 425-426.

Soil and Foundation Problems

F. L. Peckover M.E.I.C.* and T. G. Tustin JR.E.I.C.†

Soil Engineering Section, The St. Lawrence Seaway Authority

THE INTENSIVE WORK of the past six years on the design and construction of the Canadian section of the St. Lawrence Seaway project has seen the application of soil and foundation engineering practice on a scale unsurpassed on a single project in this country. The urgent schedule of the work has made it essential that delays due to unforseen soil, rock, and groundwater conditions be kept to a minimum. This need has underlined the importance of continuing soil and foundation studies from initial exploration through the design and construction phases.

This same urgency has necessarily confined the consideration of particular problems to an *ad hoc* basis. Nevertheless a number of interesting solutions have been reached among the variety of questions dealt with, and some of these will be described.

The connection of soil and foundation difficulties with the construction of canals is a traditional one. The function of canals inevitably locates them on low ground and interferes with natural geologic processes. Under such circumstances, problems of stable excavation slopes, foundations for structures, and water seepage are to be expected.

The field of soil mechanics owes some of its greatest advances to investigations which arose from difficulties in canal construction. Before 1946, Alexandre Collin, one of the less recognized pioneers of civil engineering, analyzed a number of landslides which had occurred along canal banks in France. The conclusions which he reached have been substantiated by recent investigations [1].

During the first World War treacherous ground encountered in excavating the Kiel Canal, in Germany, and slope failures which delayed completion of the Panama Canal promoted special investigations which aroused world-wide interest in the study of soil as an engineering material.

Such problems are not confined to other countries. Soil and drainage conditions along the route of Canada's Welland Ship Canal have led to many slope movements during construction and operation. These are now being analyzed and the results will add a Canadian contribution to tradition.

Site Investigations

The need for an extensive investigation of subsurface conditions along the St. Lawrence Seaway route has puzzled many engineers. The channel lies through one of the first settled, most populated and historical parts of Canada and it would be expected that construction conditions would be well established. However, for economic reasons about 80 per cent of the excavated length of the channel is in the bed of the St. Lawrence River and the remainder passes through agricultural land. This is shown in the general location plan of the route in Figure 1. For this reason detailed information on soil and rock conditions along the channel was almost completely lacking before 1952 when final design studies were started. Subsurface exploration has since played a most important and continuing part in the work.

In all, some 1,700 test borings have been made, with a total footage of 32,000 ft. in overburden and 40,000 ft. in bedrock, supplemented by numerous test pits, auger holes and other special investigations [2]. Of this total number of borings, about two-thirds were made prior to the start of actual construction. The testing of soil samples obtained from exploratory work is done in a consulting laboratory in Montreal. Boring and testing are still continuing to assist in the solution of construction problems as they develop.

For maximum economy, the means of exploration are tailored to the particular needs of each investigation. In granular soils, split spoon samples are usually taken for identification and testing, the number of standard hammer blows during sampling serving to show their relative densities. Where the general soil profile is known, the driving of a penetration cone is often sufficient to show the boundary between loose and dense materials. This test has been particularly useful for the rapid extrapolation of the results of sample borings.

Considerable time is saved in the investigation of clay deposits by using a rotating vane apparatus in conjunction with the usual "undisturbed" sampling with thin-walled tubes. More consistent values for the strength of marine clay are found *in situ* by the vane apparatus than from laboratory tests, due to the varying amount of sample disturbance. Design values for this particular clay are usually taken as two-thirds of the vane shear strength. Investigations of the marine clay at the Beauharnois upper lock site were made by these means in co-operation with the Division of Building Research, National Research Council[3].

Groundwater

Groundwater observations have a special significance in the site investigations. With the river nearby it is most important to detect water-bearing layers which may be a source of difficulty with excavation slopes and the foundations of dykes and cofferdams. Observation wells, permeability and discharge tests in bore holes, and fluoresce in dye have assisted in obtaining a complete and continuing record of groundwater occurrences where required.

During the course of this explora-

*Senior Assistant Engineer (Soils)
†Assistant Engineer (Soils)

tory program, extending over a distance of 120 miles along the river, the importance of thorough and competent drilling practice has been emphasized. If deficiencies or inaccuracies in any particular part of the work are found, they can invariably be traced to either an insufficient number of borings or observations, or inadequate inspection and logging of the results.

Table I. Typical Properties of Soil Deposits

Soil Deposits	Till				Clay		
Properties	Lachine — Upper Unweathered	Lachine — Upper Weathered	Lachine Lower	Iroquois Upper	Beauharnois — Marine Unweathered	Beauharnois — Marine Weathered	Lachine — Lacustrine
Natural Water Content (%)	15	18	10	7	57	44	28
Optimum Water Content (%)	—	15	8	8	—	30	—
Natural Dry Density (p.c.f.)	119	113	132	138	71	79	96
Optimum Dry Density (p.c.f.)	—	116	133	133	—	89	—
Liquid Limit (%)	19	—	16	—	57	68	38
Plastic Limit (%)	16	—	13	—	29	37	19
Plasticity Index (%)	3	—	3	—	28	31	19
Strength:							
Triaxial Compression			"quick" test		Triaxial compression tests made only on samples of low strength		
angle of internal friction (°)	—	—	33	38			
cohesion (p.s.f.)	—	—	1100	900			
Unconfined Compression (p.s.f.)	—	—	—	—	900	2700	1600

There is no other field of engineering in which details which may seem trivial at the time can later assume such great importance and there are few which can give the satisfaction of recognizing such details and developing their full implication.

Soil Deposits

The exploration program revealed conditions which are generally favourable for heavy construction. A brief resumé of the regional geology will show the relation of the various deposits.

The St. Lawrence River valley has been subjected to at least two glaciations, followed by an inundation by the sea and finally uplift above sea level. During glaciation the bedrock surface was reduced in relief and dense glacial till laid upon it, ranging in thickness up to 100 ft. but usually of the order of 20 to 30 ft.

Till deposits of the first glaciation are found at all locations along the Seaway route, but those from the second are found only in the International Rapids section and at scattered locations in the Lachine section. Between the two deposits, lacustrine clays and poorly graded sands and gravels are occasionally present. In the river bed, fines from the upper layer of till have been washed out leaving a mixture of coarse sand, gravel and boulders.

During submergence by the sea, the till was covered by a deep bed of marine clay, capped with marine sand. As the land surface emerged above sea level, the sand and clay were removed by erosion except for local remnants, the most important of which are at Beauharnois and Cornwall along the Seaway route.

The till generally is a most useful construction material as shown by its inclusion in nearly all dykes and its use as a seal in all rock cofferdams. It is a dense, well-graded soil mixture appearing as illustrated in Figure 2, with approximately equal silt, sand and coarse fractions in a typical sample. Wide variations occur in the proportions of silt and sand.

The marine clay found at Beauharnois and Cornwall is relatively weak and soft in its natural state and becomes very soft and sticky when disturbed by excavation. The weathered portion of this deposit is suitable for compacted fill. The unweathered portion may be considered as a general liability in construction operations.

Typical values of the engineering properties of these soils are given in Table I.

Bedrock Conditions

The stability of the bed of the St. Lawrence River can be attributed to the resistance to erosion of the glacial till and the bedrock formations of which it is composed. The river flow is controlled at intervals by outcropping ledges of the more resistant rock. A series of rapids and intervening pools is thus formed between Cornwall and Montreal. The rapids of the river, skirted by canals and locks, are thus separated by broad reaches such as Lake St. Francis and Lake St. Louis which require only dredging for improvement for navigation.

Bedrock which occurs along the river between Lake Ontario and Montreal is mainly sedimentary. Igneous rock is found in the Thousand Islands section and as intrusions in some of the sedimentary beds. The latter include shale, limestone, dolomite, sandstone, and various combinations of these.

From the viewpoint of foundation quality the bedrock is relatively free from large fault zones or folding. Bedding is generally horizontal with local dips not exceeding 10 degrees.

The limestone and shale from channel excavation are used extensively in embankment and dyke construction. The shale is a cemented nonplastic rock which disintegrates into angular particles on exposure to air. Since broken shale was readily available for use in pervious zones of the dykes, detailed studies of old shale dumps in the area were made. These confirmed that weathering of the shale does not reduce it to an impervious condition.

The geology of the St. Lawrence River region is well described in various references[4,5,6].

Design of Dykes

In the course of design and construction the problems encountered have touched on almost every aspect of the soil and foundation field. The nature of the work, however, laid heavy emphasis on problems of excavation, construction of fills, the stability of slopes, groundwater and drainage, and foundations for large structures. Other problems were generally offshoots of these major considerations.

The construction of dykes, embankments and backfills has involved placement of some 3.4 million cu.yd. of compacted fill and 9 million cu.yd. of other fills requiring treatment. Of these, the placement of compacted fill in dykes has required the most attention. The total excavated on the project was 46 million cu. yd. of overburden and 24 million cu. yd. of rock.

Nearly all the dykes required for the project are located in the Lachine section. Their function is to confine the navigation channel and keep its water level constant in the face of fluctuating river levels. The relative position of channel and dykes is therefore as shown on the plan in Figure 3 and in the aerial view in Figure 4.

Since ice jams in Montreal Harbour can cause a rise or fall of the water level in Laprairie Basin of several feet in a few hours, the rapid drawdown condition was an important consideration in the design of dykes in this area. Dyke sections were chosen to utilize excavated materials to the maximum and were zoned to suit the supply of materials and to incorporate the necessary cofferdams, where possible. The general section consisted of an impervious core of compacted earth between pervious shoulders of broken rock. The zoning of this section was varied depending on the importance of the dyke as illustrated by the two typical sections in Figure 5.

Glacial till proved to be an ideal material for the impervious core and broken shale or limestone was used for the pervious shoulders. High factors of safety were inherent due to the granular nature of all the materials.

Water-bearing layers found in dyke foundations were blocked, either by a cutoff of impervious fill under the centre core for section (a) of Figure 5 or by a blanket of impervious fill extending as far down on the channel side as necessary for section (b).

Construction of Dykes

The construction of dykes was started in the spring of 1955 and is now complete. This schedule required the placement of compacted fill at rates as high as 225,000 cu.yd. per month by individual contractors.

Compaction of both the glacial till and clay was carried out almost without exception by sheepsfoot rollers although other means of rolling were permitted. A view during placement of one of the larger dyke fills is shown in Figure 6. At junctions of earth fill with rock foundations and con-

Fig. 2. Typical exposure of glacial till.

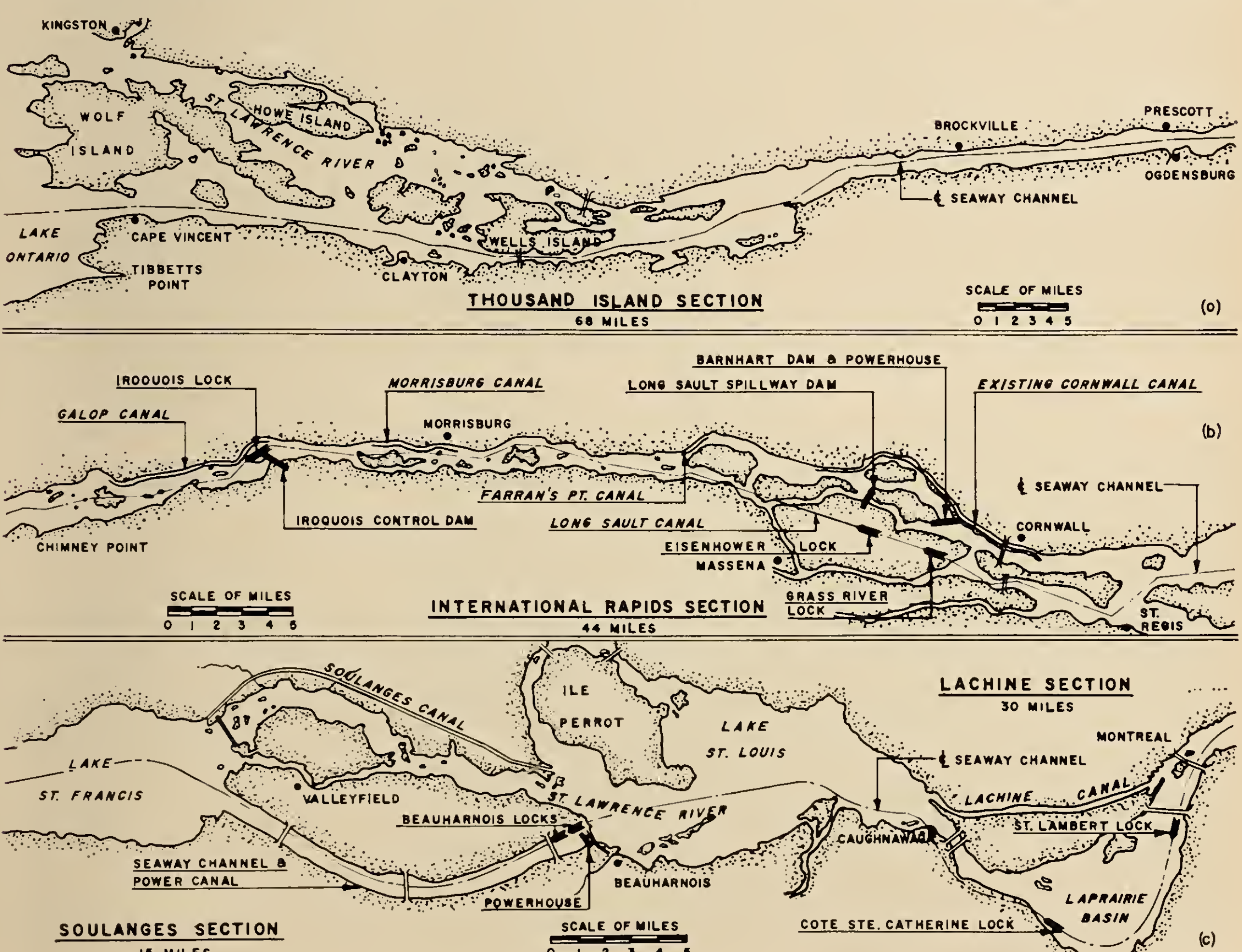


Fig. 1. General location plan of Seaway route.

crete walls, power tampers were originally specified for compaction. However, in practice it was found to be more satisfactory and economical to use heavy loaded trucks. The squeezing action of the truck tires was particularly effective in compacting fill over irregularities in rock and against sloping concrete walls.

Winter Compaction of Fills

On some occasions it was found necessary to compact small quantities of earth fill in winter to meet construction requirements. Materials so placed were not allowed to remain in important fills. When unavoidable the problem was successfully met in all but the most extreme weather by working rapidly with heavy equipment in small areas.

The fill material was spread in 6-in. layers and frozen clods were removed. Heavy loaded trucks were used for compaction in preference to sheepsfoot rollers in order to leave a minimum surface area of fill exposed to the air. The densities thus obtained were in the range of 90 to 95 per cent of standard Proctor density for both glacial till and clay, except when the temperature was too low.

It was found that freezing of the earth before compaction, resulting in lower densities, occurred at a temperature which was characteristic for each type of fill material. For till at a water content of 10 per cent this temperature was about 20° F., whereas with weathered marine clay at a water content of 24 per cent it was near 0° F. The difference seems to be associated with the higher water content and latent heat of fusion of the clay.

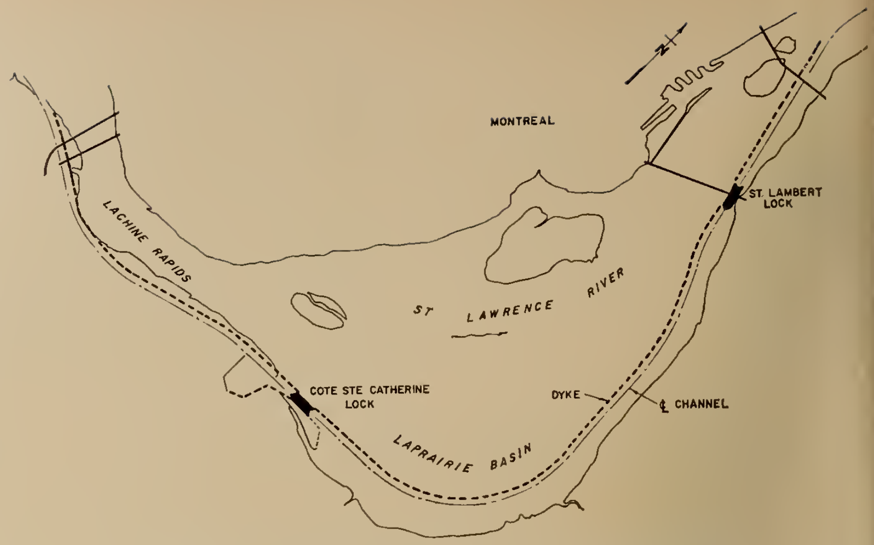


Fig. 3. Location of channel and dykes in Lachine section.

Compaction Control

The practical field control of the compaction of glacial till is not difficult. The soil as obtained from the borrow pit usually has a water content slightly higher than required. The grading of the material and its consequent very low void ratio is such that the addition of only 2 or 3 per cent of water softens it and prevents the successful operation of the hauling equipment over the fill. Material placed at natural water content is always trafficable. Good drainage at both the borrow face and the fill is needed to handle the material effectively.

Field control testing for compacted fill operations was done in three regional field laboratories, supplemented by a mobile testing unit which proved most useful for isolated parts of the work.

The density of fill in place was checked against the standard Proctor density of the soil used, to ensure adequate strength and watertightness. Early in the program, however, it was found that the usual field density test, involving measurement of the volume of a hole dug in the surface of the fill, was difficult and time-consuming on account of the high density and number of stones. A means of direct volume measurement was therefore used which gave results consistent with standard methods.

Representative chunks of soil quickly dug from the fill were immersed in a cylinder filled with oil and their volume found by displacement. The apparatus is pictured in Figure 7. The method is naturally limited to soils with low permeability and some cohesion, but gives satisfactory results with some elementary precautions.

Fig. 4. Aerial view of channel and dyke; Laprairie Basin toward Montreal Harbour.

Fill Performance

The performance of various fills has been followed closely. In some locations dykes were subjected to high water levels in winter while the adjacent navigation channel was dry. Leakages observed in such extreme conditions were satisfactorily small.

In many locations the performance characteristics of fills have been followed by means of measurements of various types. Measurements were taken in connection with a roadway embankment on Cornwall Island which was founded on dense till after 20 ft. of clay were excavated from the foundation area. The embankment fill, which was also glacial till, was compacted against the natural clay along the side of the excavation on a face which was nearly vertical. The general proportions of the fill are shown in section (a) of Figure 8.

Calculations showed some possibility that the lateral component of the weight of the embankment might rupture a wedge of the clay and cause damage to the body of the fill. To check on any tendency of the clay to squeeze thus, a number of plastic pipes, sealed against the entry of water at the lower end, were installed vertically at the location shown. These were checked visually for plumb during construction by lowering a flashlight inside. The embankment is now complete and no movement of the clay has been detected.

Settlement of Fills

Another section of this same embankment is founded on the surface of the clay. Here, it was of concern to follow the progress of settlement of the top of the fill before final grading and paving were done. Since this total settlement was the sum of the consolidation of the compacted embankment fill and of its clay foundation, it was desirable to measure these two effects separately. To do this, a pipe was laid from the centre to the edge of the foundation area of the fill. Short vertical sections were added to the ends to enable the pipe to act as a manometer. The compacted fill was then placed. This installation is shown schematically in section (b) of Figure 8. By adding water at the outer end of the pipe until it overflowed at the inner end, changes in the level of the embankment foundation were measured and, with the aid of bench marks on the top of the fill, the separate consolidation effects evaluated.

Settlement observations on fills have been useful in dealing with many problems and have been made from the start of construction. As work in the vicinity of the locks progressed it became necessary to found structures on various fills which had been in place for varying times, and the rate and degree of settlement to be expected of these fills became a matter of importance. The problem, as with so many others, was aggravated by the close scheduling of the work.

Some of the fills involved were built as roadways, embankments or working areas, but many were simply backfills for lock or approach walls, or random disposal. Of the fill materials, only compacted glacial till was in any way subject to consolidation according to the conventional theory. Others were generally granular, ranging from mixed earth and rock to heavy igneous rock. Some were required to be compacted by construction traffic but most received no special treatment during placement and some were even dumped in water. Settlement of these fills was due to subsequent traffic, slow weathering and the fracturing of overstressed particles.

A search of literature on the problem showed little available information, mostly referring to rockfill dams in which the fill placement was carefully controlled. Fills of many types and sizes on the project were therefore put under observation and the conditions of placement noted. At one time, more than 100 observation points were being checked.

Although preliminary, the findings have been applied to many foundation problems. Some of the basic data are given in Figure 9. Measurements were started at an arbitrarily chosen time of 10 days after fills were completed, as their initial rapid settlement was not usually of practical sig-

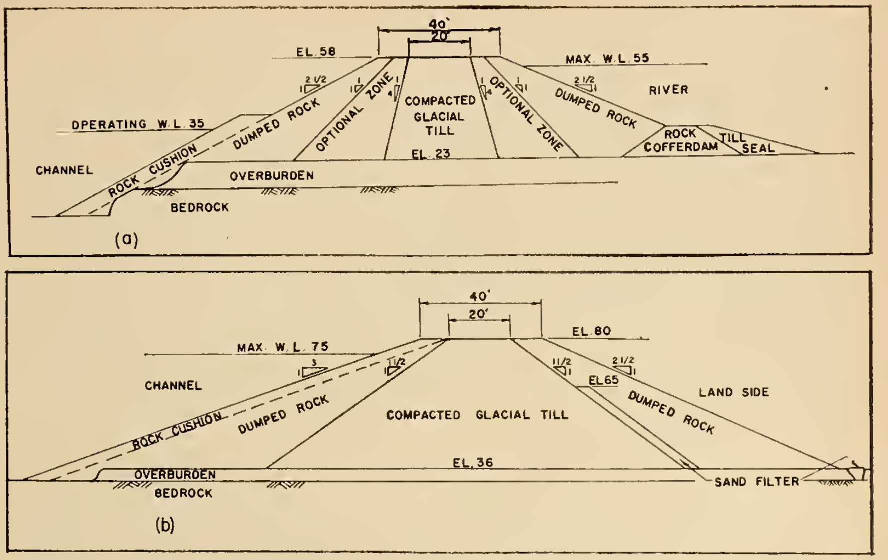


Fig. 5. Typical dyke sections: (a) for heights up to 20 ft.; (b) for heights from 20 to 40 ft.

Fig. 7. Oil immersion apparatus for field density testing of soils, with lowering basket and sample.

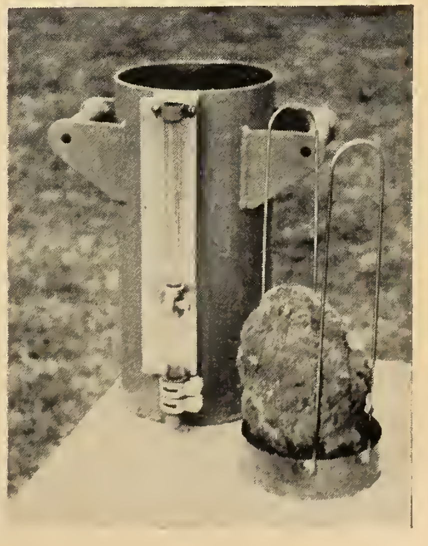


Fig. 6. Compacting glacial till in impervious core of dyke.

nificance. Due to the complexity of construction operations, simple examples of uninterrupted fill placement were seldom found and some of the individual results varied widely from those shown. The large number of observations taken compensate in part for this, but the curves should be applied cautiously with allowance for natural variations between these materials and those elsewhere.

One of the problems associated with the settlement of fills involved some of the dykes built according to section (a) of Figure 5. Longitudinal cracks appeared at the junction of the compacted till core and the broken shale zone on the outer side and these were followed shortly afterward by supplementary cracks near the centre of the core. The first appearance of these cracks seemed to coincide with a sudden rise in the river level against the dyke. Subsequent measurements showed that the differential settlement between the two zones was suddenly increased by inundation of the broken shale. The cracks near the centre of the compacted earth core were induced by friction with the shale as it settled.

Cracking was confined to portions of the dyke which were subject to low heads and was not considered serious enough to warrant repairs. Test pits were excavated and it was shown that the cracking did not recur after the large initial settlement of the shale had passed. In later construction the slope of the till-shale boundary was flattened to 1 on 1 to increase the stability of the core and no further trouble was met.

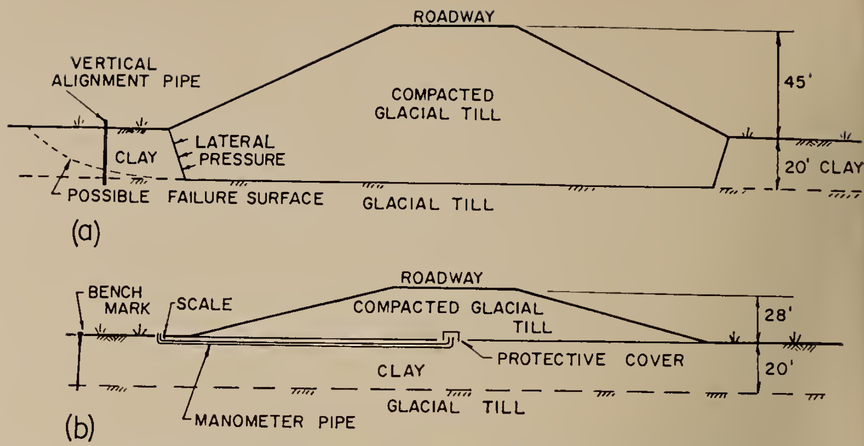


Fig. 8. Measurements on highway embankment on Cornwall Island: (a) for lateral movement of clay; (b) for vertical movement of clay.

Foundations for Lock Structures

The Seaway locks and approach walls are concrete gravity and semi-gravity structures, ranging in height from 38 to 87 ft. They are generally located so as to be founded on bedrock. An exception is Iroquois lock where approximately 2,500 ft. of the upper approach wall rests on glacial till.

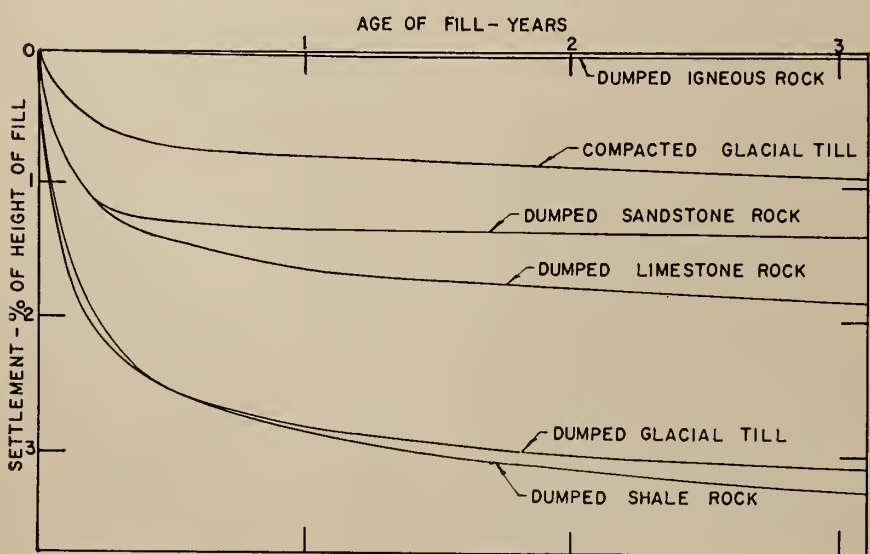
Evaluation of a safe bearing value for till is not usually a problem in ordinary construction since it is amply strong and dense to support the heaviest loads (see properties in Table I). At Iroquois lock, however, the differential settlement of adjacent wall monoliths was a construction as well as a design consideration, and bearing values on this basis were required. Loading tests were quite unsuitable for this purpose because of the very dense and stony nature of the soil.

Indirect means of evaluation were therefore used. Standard penetration test results were corrected for the high silt content of the material and applied on the assumption of 1.0 in. of allowable settlement[7]. This gave a value of 6 t.s.f. for a continuous wall 32 ft. wide.

Samples of till obtained from borings were then recompacted to natural density and water content and subjected to consolidation tests in the laboratory. Calculations based on the results of these tests showed a settlement of 0.7 in. to be expected under a unit load of 6 t.s.f. This design bearing value was therefore used.

The natural density of the till is so great that it is difficult to imagine any noticeable settlement taking place under a loaded area. However, careful measurements taken during construction on one of the wall monoliths showed an average settlement of 0.4 in. under the front edge with full backfill. Considering normal variations in test methods and natural soils, this agreement with calculated values seems reasonable.

Fig. 9. Typical time-settlement curves for granular fills.



Shale Foundations

The main lock structures are variously founded on dolomitic limestone at Iroquois, sandstone at Beauharnois, and shale at Cote Ste. Catherine and St. Lambert. Of these, the only deposit which warrants special mention is the shale.

Its tendency to weather rapidly on exposure to air has already been noted. For this reason it was necessary to protect shale surfaces which were prepared for concrete. Early in the work a number of different protective coatings were exposed on a test area of shale. Best protection was found to be given by two spray coats of bituminous mastic. This treatment was subsequently used on all shale surfaces which were to be left exposed for longer than one week. For exposures longer than one month it was found that disintegration had commenced even where a protective coating was applied but this did not assume serious proportions unless exposures lasted longer than three or four months.

Groundwater Problems

As would be expected in a construction project of this size, involving continuous excavation along miles of river bank, water seepage into work areas was the rule rather than the exception. Records of flows and levels were maintained where the work was affected.

The various sources of leakage soon became well recognized. The boulders and coarse material strewn over the river bed sometimes increased the difficulty of making an effective earth seal for rockfill cofferdams, and always impeded the driving of sheet pile cutoffs for timber crib types. Fortunately, this river bed material was sufficiently well graded to minimize the danger of piping.

In excavation work, groundwater occasionally flowed from lenses of uniform sand within the till but these did not usually connect with a permanent source of water and could be drained. The actual quantity of water involved was invariably small.

The chief source of water in all excavations was the sedimentary bedrock. Shale, found between Montreal Harbour and Cote Ste. Catherine was generally massive in structure and yielded little water. Limestone, underlying the channel between Cote Ste. Catherine and Lake St. Louis, was weathered in the top few feet and contained occasional faults. It gave little water in most areas, but produced as much as 15,000 g.p.m. in a particular 3,000-ft. length of channel. Observation wells here showed that the drainage effected sufficient drawdown to reduce greatly the uplift under adjacent earth slopes. No internal erosion of slopes was observed and with continuous pumping the excavation proceeded on schedule.

The sandstone, and particularly that underlying the Upper Beauharnois Lock site, produced the greatest quantity of seepage. This rock is weathered to a depth of a few feet and contains zones of shattered rock. In some locations the shattering has been extreme and left a pulverized material which acts as a barrier to the water circulating through the general joint pattern. More often, however, the rock is broken to such a degree that it channels the water in large quantities.

Fig. 10. Identical views of approach to Upper Beauharnois lock, looking west along power canal: (a) before work started; (b) before flooding to dredge out canal dyke.

Site Conditions at Beauharnois Upper Lock

Since the site conditions at Beauharnois were responsible for the most difficult excavation and drainage operation on the entire project, some of their details may be of interest.

The Beauharnois power canal has been dredged since 1930 by successive stages to conduct water from Lake St. Francis to the Beauharnois powerhouse (see Figure 1). The canal provides, by agreement with the federal government, a navigation channel along its north side from which ships will enter the Beauharnois locks.

Dredging of the canal has changed the groundwater conditions in the area considerably. It introduces an unlimited source of water directly to the bedrock at a head some 12 ft. higher than the original groundwater table. As a result, the blanket of soft marine clay overlying the bedrock in the vicinity of the canal is under artesian pressure from this fresh source of water below.

Numerous test borings made prior to the start of the work at the upper lock site showed flows of water under artesian head. To gather additional subsurface information a braced and sheeted test pit was put down to bedrock in the approach area. In conjunction with this, a pumping test was done and the effectiveness of sheet piling and grout as a cut-off was noted. The sheet piling reduced seepage through a thin layer of coarse-grained till lying between the soft clay and bedrock and grouting reduced seepage through the rock but, even in combination, they were not effective to a satisfactory degree.

The approach area to the lock appeared as in Figure 10 (a) before any work was started. The general layout in this area is shown in Figure 11 (a). The construction plan which was adopted required the installation of a sheet pile wall driven to rock along the canal dyke before the start of any excavation. This wall was not intended to reduce seepage but rather to strengthen the dyke to resist any piping which might develop.

Initial excavation was then made, limited as shown on the plan to that necessary to build a barrier secure against the possibility of an accidental breaching of the canal dyke. This barrier consisted of a clay dyke, the approach wall, sheet pile cells across the future entrance for a twin lock, stop logs between the two present lock walls, and a sheet pile wall between the lock and the canal dyke.

On completion of the barrier the remaining dry excavation was continued to safe limits inside the canal dyke. This stage is pictured in Figure 10 (b). The excavation was then flooded, the sheet pile wall removed, and the dyke and remaining overburden and rock removed by dredging. This plan was carried through satisfactorily, but only with the most careful attention to changing conditions as the work progressed.

Of considerable help in dealing with changing groundwater and soil conditions promptly and with adequate facilities was a special item included in the construction contract. This called for the supply of equipment and personnel at any time on a cost plus basis to do drilling and sampling, drainage trench excavation, pumping, grouting, and pile driving. This item was instrumental in promoting safety and avoiding delays in the work on many occasions.

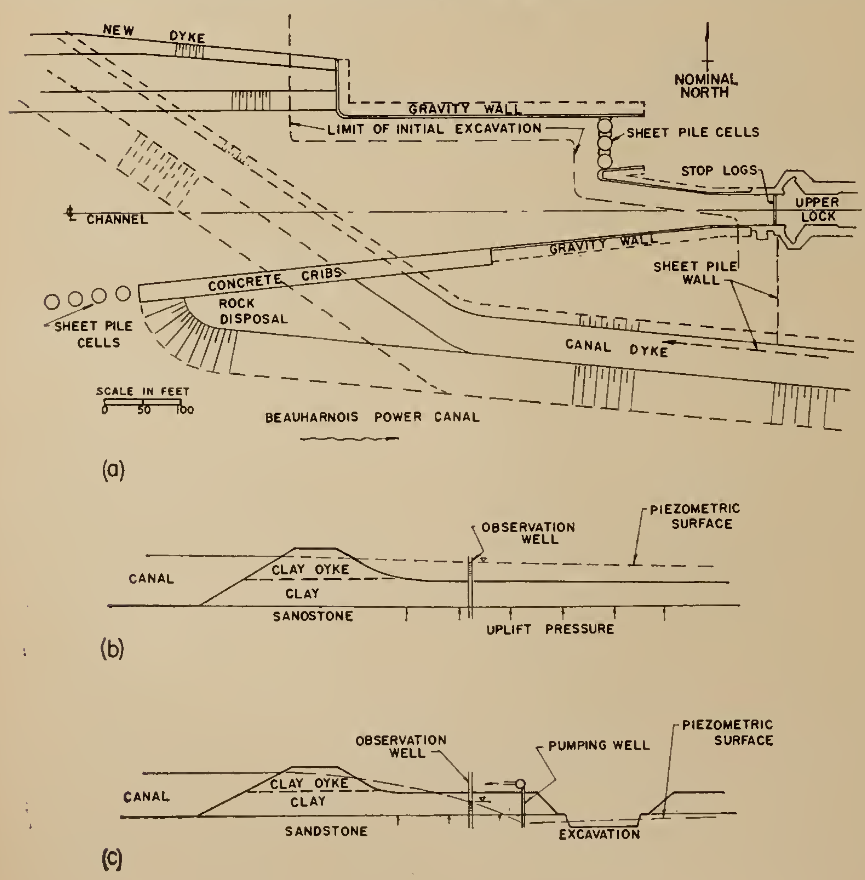
Groundwater Control during Excavation

The artesian head under the clay blanket at the start of the work was such that excavation to a depth of only 10 ft. over any appreciable area would have caused uplift and rupture of the layer with consequent possible piping through the canal dyke. These conditions are shown schematically in section (b) of Figure 11.

The first step in maintaining control of the groundwater problem was the installation of a pattern of observation wells to enable pressures throughout the area to be checked at any time. These wells were maintained throughout the work and proved essential in evaluating each new development affecting the groundwater.

The second step was drainage. The excavation was carried down to bedrock in one lift. This was so that natural drainage could take place and reduce the uplift pressure ahead of the excavation face. The effect was assisted by drainage trenches dug in advance of the general excavation.

Fig. 11. Control of groundwater conditions at Upper Beauharnois lock. (a) Plan of approach area. (b) Groundwater conditions at start of work. (c) Groundwater conditions as maintained during excavation.



This type of drainage was observed by means of the wells to have a far-reaching effect on the piezometric head, sufficient in itself to insure against the possibilities of uplift and piping.

As the initial excavation proceeded west and approached the inner side of the canal dyke, it became necessary for safety to achieve a drawdown additional to that from natural drainage. Pumping was therefore started from three 12-in. wells, drilled into bedrock around the western perimeter of the excavation area. One of these wells proved to be particularly effective due to its fortuitous location in a shattered bedrock formation supplying most of the water to the area. With a specific yield of 275 (g.p.m. per ft. of drawdown) this well produced a drawdown of 4 ft. at a distance of 250 ft. It remained in continuous operation until the excavation was finally flooded in July 1958.

When the permanent barrier was being constructed during the winter of 1957-58, groundwater conditions were maintained as shown schematically in section (c) of Figure 11, with respect to the excavation slopes. The total flow into the excavation was steady at about 10,000 g.p.m.

Between March and June 1958 the clay and rock excavation in the remainder of the area was carried out. Each successive rock blast increased the flow of water noticeably until the total inflow was more than 30,000 g.p.m. This was finally turned to welcome advantage in flooding the area by simply stopping the pumps.

Throughout the construction operation, a thorough knowledge of site conditions combined with constant observations of groundwater levels, pump discharges and slope performance gave assurance that the critical water and soil problems which have been described could be dealt with promptly and effectively.

CONCLUSION

This review has dealt with some of the major soil and foundation considerations in planning and construction of the St. Lawrence Seaway. The cost of the subsurface exploration and testing phase of this work has been about one-quarter of one per cent of the value of contracts directly involved. Design, assistance with the preparation of contracts, and construction consultation and control

(Concluded on page 68)

St. Lawrence River Diversion by a Rockfill Cofferdam

J. V. Danys, M.E.I.C. *Senior Soils and Foundation Engineer,*
St. Lawrence River Joint Board of Engineers, Canadian Section, Cornwall, Ont.

IN BUILDING the gigantic St. Lawrence Seaway and Power Development in the International Section of the river between Cornwall and Prescott, Ontario, engineers were faced with a number of problems which had to be solved during design and construction. One difficult and spectacular problem was the harnessing of the river during the construction period. With an average flow of 240,000 cubic feet per second the St. Lawrence River is one of the largest in the world. Fortunately for construction and power development, the Great Lakes regulate the flow almost ideally. In the past the maximum mean monthly flow was 265,000 c.f.s., and the minimum mean monthly flow was 212,000 c.f.s.; recorded maximum and minimum daily flows were 330,000 c.f.s. and 152,000 c.f.s.

The St. Lawrence River was harnessed by numerous cofferdams while building the Seaway and Power Development. Spectacular diversion of 200,000 c.f.s. near Long Sault Rapids at Cornwall was made by a rockfill cofferdam. Work was complicated by swift currents and necessary co-ordination of construction operation with navigation and power development.

Sequence of operations and size of stones required for various stages of construction were planned in advance, but in the field operations were adjusted according to the available material and changing conditions.

Construction of the cofferdam supplied very useful information concerning the building of rockfill cofferdams in swift current and proved to be economical.

Many different types of cofferdams were built for the various structures. The largest of the entire project was the downstream cofferdam at Barnhart Island powerhouse (Fig. 1). The cellular cofferdam, designated cofferdam "C-1", spans the 3,600 ft. wide river channel between the southern tip of Barnhart Island and the Canadian shore. Steel cells are 65 ft. in diameter and up to 65 ft. high. This cofferdam was probably the largest of its type ever built, but the most spectacular construction of a cofferdam and diversion of the river was during the second stage construction of Long Sault dam. A cofferdam (cofferdam "E") was required immediately upstream from the famous Long Sault Rapids to divert the entire river flow.

FOUR CONSTRUCTION STAGES

Long Sault dam is located at the western end of Barnhart Island. It closes the southern channel of the river just at the eastern tip of Long Sault Island. The south abutment of the dam is located on the right bank of the river, and the north abutment reaches Barnhart Island. Construction of the dam was planned in four stages.

In the first stage, the cellular cofferdams "A" and "B" (Fig. 2) provided a dry site for the first half of Long Sault dam in the south Long Sault channel of the river. A temporary cut (cut "C") was excavated to divert the flow of the south channel. In this stage, concrete piers had to be built to final height, but the spillway rollways were to be built to elev. 162 only, (roughly as high as the river bottom) and 55 ft. short of the final height. Spillway openings had to be adequate to discharge the entire river flow without raising the water levels at Dickinsons Landing lock, some two-and-one-half miles upstream.

Second stage construction of the dam had to be in the north channel of the river, and it was necessary to divert the entire flow to the south Long Sault channel. Under natural conditions, the south channel carried only some ten per cent of the entire flow. To accommodate all flow, a 600 ft. wide cut (cut "F") had to be excavated through Long Sault Island. Also, the south channel near the dam had to be widened. Cofferdams "E" and "D" were required to unwater the site for the second stage construction of the dam (Fig. 2).

In the third stage, the river was diverted back to the north Long Sault channel, and the entire flow was discharged through 34 tunnel ports, each 16 ft. by 18 ft. in the second half of the spillway. In this stage, the spillway rollways of the south half of the dam will be raised to the final height.

In the fourth stage of construction, the discharge tunnels will be plugged after the water has been raised in the reservoir.

The most difficult stage was the second one, because the entire flow of 200,000 c.f.s. had to be rerouted by a cofferdam through cut "F" into the south Long Sault Island channel. The designers first proposed to build a rock-fill cofferdam with an impervious blanket on the upstream side. However, the contract was let with a stipulation that cofferdam "E" was the full responsibility of the contractor, and that alternative closure methods might be used, if approved. In fact, the contractor did choose the design method with some minor variations.

Co-ordination of Construction Operations

Construction of cofferdam "E" was difficult because of the huge flow in the river, and because of the swift current. But there were a number of additional factors affecting its construction.

The existing 14 ft. draught Cornwall navigation canal starts at Dickinsons Landing, some 5000 ft. upstream from the site of cofferdam "E", and lock 21 is located near the entrance to the canal. Water level at the lock may fluctuate only 4 feet without disturbing navigation. Therefore, all excavation and construction work at cut "F" and cofferdam "E" had to be carried out so as to maintain the river levels at lock 21 during the navigation season within these limits.

At the west end of Long Sault Island a diversion canal takes approximately 25,000 c.f.s. for ALCOA's hydro plant in Massena, N.Y., returning it to the St. Lawrence River via the Grasse River. Water levels could not be drawn below the natural river levels during the winter as this would cause head-loss at the entrance to the power canal and, consequently a reduction of power output. Also, any sudden large flow retention or release was not desirable because of power developments downstream from Cornwall and navigation in Montreal harbour.

Long Sault Rapids before construction of cofferdam 'E' (PASNY)

Construction Operations Checked by Hydraulic Models

Thorough planning and co-ordination of all river diversion operations was required. The hydraulic laboratory of Hydro-Electric Power Commission of Ontario, at Islington, did extensive model testing and set up a program for construction operations as follows:

(*a*) A plug had to be left in cut "F" after the cut was excavated to grade.

(*b*) A "choke" dyke had to be built at the shore of Long Sault Island opposite lock 21. This dyke would be extended into the river so as to maintain adequate water levels at the entrance to lock 21. Without the choke dyke, necessary excavation upstream from the plug in cut "F" would have lowered the water levels at the entrance to the navigation canal and lock.

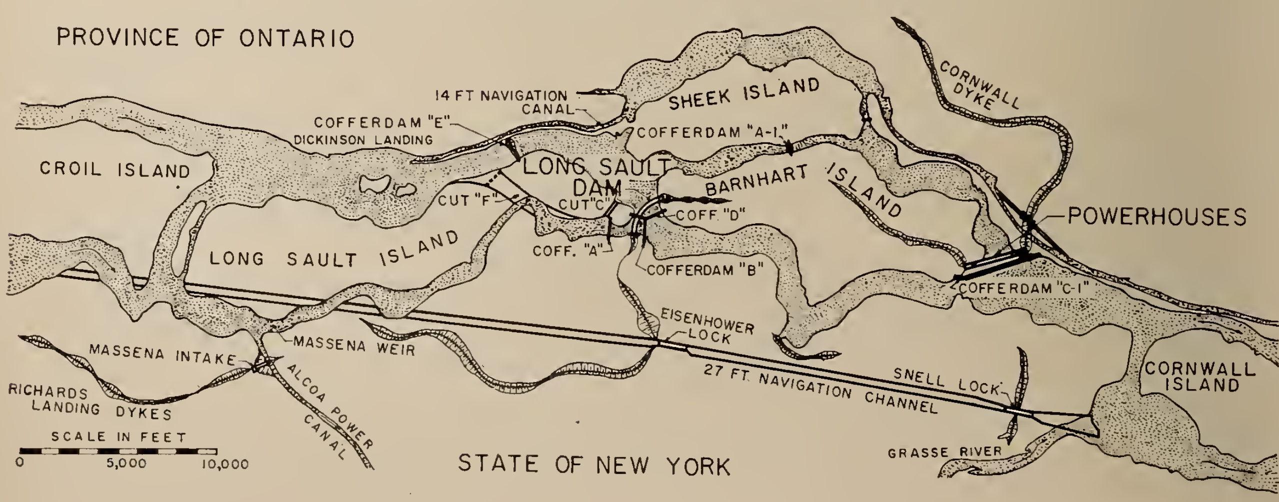
(*c*) Certain heights were established to which the rockfill could be built as a submerged weir without any adverse effect on water levels. The choke dyke had to be removed gradually when cofferdam "E" was being built to elev. 179. After the cofferdam reached elev. 179, a further increase in height could be made, only if the plug in cut "F" was removed for a sufficient width to provide an adequate additional area for the flow through the south Long Sault Island channel.

(*d*) Thirteen sluices with temporary gates had to be completed in the Long Sault dam before breaching the plug in cut "F". After removal of the plug, and completion of cofferdam "E", river levels had to be controlled by operating these gates.

Planning of Cofferdam Construction

Rockfill cofferdams with an earth blanket are common structures today. Generally their construction is much simpler than any other type, and very often they are the most economical. The simplest and most common way to build a rockfill cofferdam is by end dumping of rock into the river

Fig. 1. General plan of structures in Cornwall, Ont., and Massena, N.Y., area.



from one or both shores. Of course, as the gap becomes narrower, the stream velocity is increased and, generally, there is a critical stage which is difficult to overcome merely by continuing to dump rock of the same size, as rock must be heavy enough to withstand the moving forces of flowing water.

Constructors of the cofferdam at Long Sault Rapids had to consider the very large flow and comparatively great velocities. Such a large flow, naturally, makes the task much more difficult as restricted flow creates velocities and forces of momentum which cannot be met by speedy rock placing. Uniform river flow was advantageous for construction as all operations could be planned for a known discharge. Diversion of flow through cut "F", with the bottom elevation approximately at the same level as the average elevation of the river bed at cofferdam "E", also facilitated construction of the cofferdam.

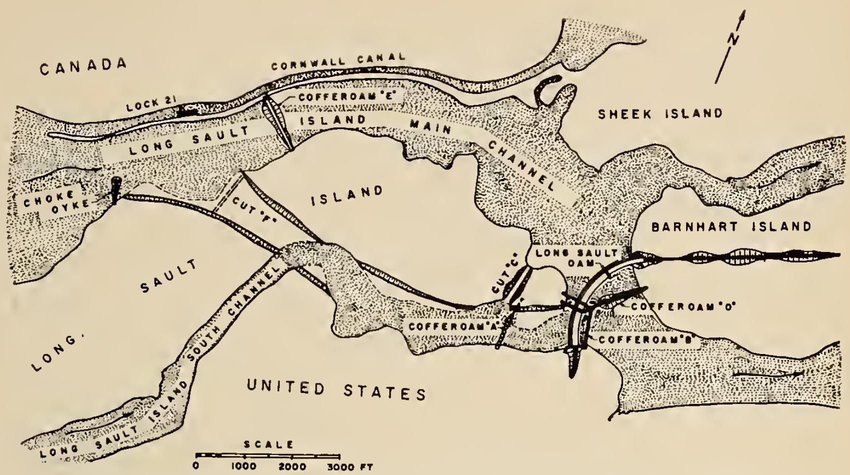


Fig. 2. General plan of cofferdam 'E' and structures in vicinity.

Already early design (1941) had emphasized the difficulties of building a rockfill cofferdam in the swift and very large stream. Fig. 3 indicates the measured mean velocity, 7.4 f.p.s., and the maximum velocity, exceeding 10 f.p.s. at the surface. Use of an overhead cableway and skip was suggested for dumping rockfill into the water. The cofferdam would be built in horizontal layers; it would be raised slowly, and thus diversion of the flow through cut "F" would be gradual.

One of the early designs for the cofferdam (Fig. 4) indicates big stones on the downstream slope. This barrier of big stones should be able to withstand the increased velocities and would give support for small or quarry-run rock.

First, following experience at the McNary dam on the Columbia river, it was suggested that 8- to 12-ton stones be used for the heavy rock zone of the cofferdam. The heavier rock had to be in the lower zones (Fig. 4: A, 24,000 lb.; zones B and C, 20,000 lb.; and zone D, 16,000 lb.). Later, ascertaining the necessary size of the heavy stone was tried by theoretical calculations. Model investigations by S. Isbash[1] were studied and, using his suggested charts (Fig. 5) for assumed hydraulic and structural conditions, the weight of the required heavy stones was calculated to be from 1 to 7 tons. It was also suggested that the heaviest rocks should be placed in the middle zones of the heavy rock barrier. (Fig. 4: zone A, 2,500 lb.; zone B, 6,500 to 14,000 lb.; zone C, 14,000 to 5,000 lb.; and zone D, 200 lb.)

View of site after start of construction of cofferdam 'E'. Water ripples left of island indicate location of partially built cofferdam. Cut 'F' across Long Sault Island is also seen at right; upstream plug is still in place. Dickinsons Landing (lock 21) is at left. Long Sault Dam under construction in background at right. (PASNY)

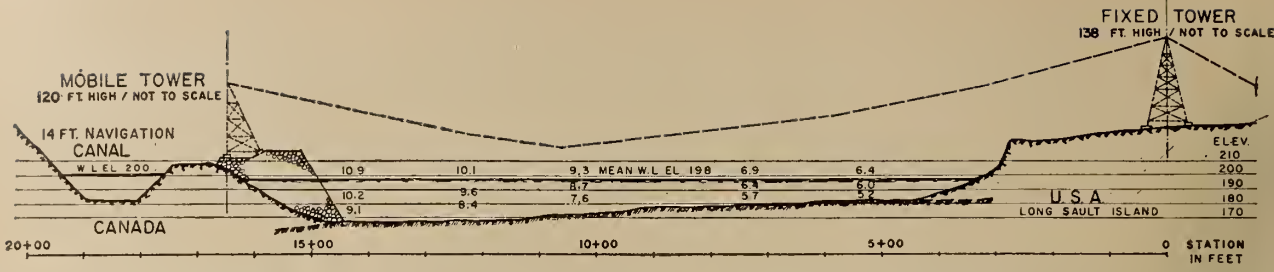


Fig. 3. Profile along centre line of cofferdam 'E' and arrangement of cableway for dumping rock into river. Measured velocities in feet per second are shown for the total river flow of 250,000 c.f.s., of which 204,000 c.f.s. were discharged through the north Long Sault channel. Mean velocity was 7.4 f.p.s. and maximum velocity 10.9 f.p.s.

After the work had started, it was thought that a satisfactory barrier could be built with much smaller rock than earlier suggested. It was suggested that stones from 800 lb. to 2,000 lb., placing the heaviest stones in the middle zones, would be heavy enough for a rock barrier. (Fig. 4: zone A, quarry-run rock; zone B, 2,000 lb.; zone C, 1,000 lb.; and zone D, 500 lb.)

Experience indicated that none of the above assumptions was quite correct. As a matter of fact, design was empirical or semi-empirical, without any model testing. The available rock, moreover, was not suitable to produce stones of the specified weight without going into great cost. Hydraulic calculations and checking progress in the field helped to direct construction of the cofferdam, adjusting the operations to suit available material and equipment.

An overhead cableway was installed for placing rock (Fig. 3). It was felt that rock should be placed in thin horizontal layers, which would gradually divert more and more water through cut "F".

A fixed tower was located on Long Sault Island, and the mobile tower placed at the canal embankment on the Canadian side. The loading capacity of the skip was 25 tons, and the mobile tower could move 200 ft. along the shore. All operations of the skip and the mobile tower were automatically controlled from an operating room.

COFFERDAM CONSTRUCTION

Dumping of rock for the cofferdam was started by a cableway and continued to elev. 188. Water level in the river during construction was approximately elev. 198. Then, the upper part to elev. 207 was completed by end-dumping of rock by Euclid trucks. Actual operations were done more or less in three typical stages.

First Stage—Small Rock

In the first stage, no rock selection was made at all. A few experiments indicated that the stream would carry a 100 lb. stone about the same distance as the depth of the river at the rock dropping point. Rather fine rock with a considerable amount of spalls excavated from nearby cut "F" was dumped by the skip. Of course, fines and rock spalls, which made some 30 per cent of the volume, were washed away by the stream. The short haul and easy loading compensated for the loss of fines.

The average size rock was some 9 inches in diameter and weighed about 50 lb.

In this stage the cofferdam was raised to elev. 183 and the mean stream velocity over the crest increased from 7.5 f.p.s. to 12 f.p.s. During the interim stage, when the cofferdam was built to elev. 174, the mean velocity was 9.5 f.p.s., and the maximum velocity at the water surface was measured as high as 14 f.p.s.

Second Stage—Heavier Rock

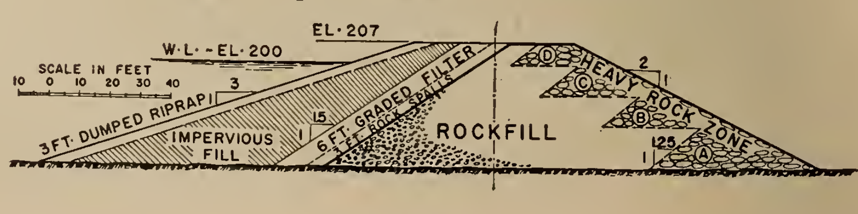
In this stage the cofferdam was raised from elev. 183 to elev. 188. Rock was dumped by skip, but heavier rock was necessary as the mean velocities over the crest increased to about 13.5 f.p.s. Part of the river flow was diverted through cut "F" as the plug was being removed and the gates at Long Sault dam were gradually opened. In this and in the following stages, no direct measurement of velocities was made. Velocities were computed from the known discharge through the measured flow area on the crest of the cofferdam with the estimated velocity coefficients for the various observed flow conditions.

Care was taken to pick up larger rocks and to place them on the downstream side of the cofferdam in such a way that smaller rock would be retained by the barrier of heavy rock (Fig. 4). Rock was taken from a quarry four miles away from the cofferdam, just east of Sheek Island. Quarry-run rock was dumped by the cableway skip into the cofferdam. Rock varied in size from 1 to 60 inches, weighing up to 10,000 lb., but the average rock was some 20 inches in diameter, weighing approximately 500 lb.

Formation of rock in the quarry where most of the material was obtained was not suitable to produce heavy rock. Several feet of the upper rock consisted of thick, large, flat blocks of dolomite. The deeper layers of rock were parted by numerous shale interbeddings, and blasting produced comparatively small rock with a very high percentage of fine rock and spalls.

It was obvious that selection of rock of a certain size would be very expensive. Some sorting of the truck loads was attempted, but generally rock was used as produced in the quarry, and the major portion of the cofferdam was built from unsorted rock. A number of big boulders and large pieces of rock excavated from cut "F" were stockpiled to one side

Fig. 4. Proposed cross-section of cofferdam 'E'.



and individually dumped in certain locations in the cofferdam.

In the first and second stages of the cofferdam, an effort was made to deposit the rock in uniform horizontal layers within the designed outline of the cofferdam (Fig. 4). The cableway operator had a schedule indicating the number of loads to be placed in certain locations. Periodical survey with echo sounding equipment was carried out to determine the shape and height of the rockfill during the various stages of construction. According to the survey results, additional rock was placed in low areas in order to ensure uniform rise of the cofferdam and to avoid flow concentration and high velocities at certain points.

Third Stage—Dumping from Trucks

In the third stage the upper part of the cofferdam, from elev. 188 to elev. 207, was built by dumping rock from trucks. At this stage the gap was gradually narrowed and removal of the plug in cut "F" continued. More and more water was diverted through cut "F". Mean velocities of the current on the crest through the gap of cofferdam "E" were gradually increased from 13.5 to some 15 f.p.s., and later they remained rather constant on the crest of the rockfill because the flow per lineal foot of opening remained more or less constant, owing to gradual water diversion. But, at later diversion stages, tailwater dropped fast and increased the velocity of the overflowing water at the toe of the cofferdam to approximately 24 f.p.s.

End of second stage construction of cofferdam 'E' by dumping rock from cableway skip; rockfill is built within 10 ft. of water surface. (PASNY)

Closure

The actual cross-section of the cofferdam, as built, differed considerably from the suggested section. In Fig. 6 one can see the actual sections of the cofferdam as built. The downstream slope became flatter as the gap for the flow was being narrowed. Although the flow per linear foot was kept fairly constant as gates at Long Sault dam were gradually opened, coinciding with the closure of the cofferdam, the tailwater at the cofferdam was consistently lowered because of a smaller volume of the total flow downstream from the cofferdam. This accounted for the continuous increase of sweeping velocities on the downstream slope of the rockfill near the tailwater level. The increased sweeping velocity carried the dumped rock farther and farther from the centre line of the cofferdam.

The closure of the last hundred feet of cofferdam presented some difficulty. The mean velocity of the flow reached its maximum, about 17 f.p.s. on the crest and 28 f.p.s. at the tailwater, and erosion started on the south end of the cofferdam near the island where a channel about 50 ft. wide

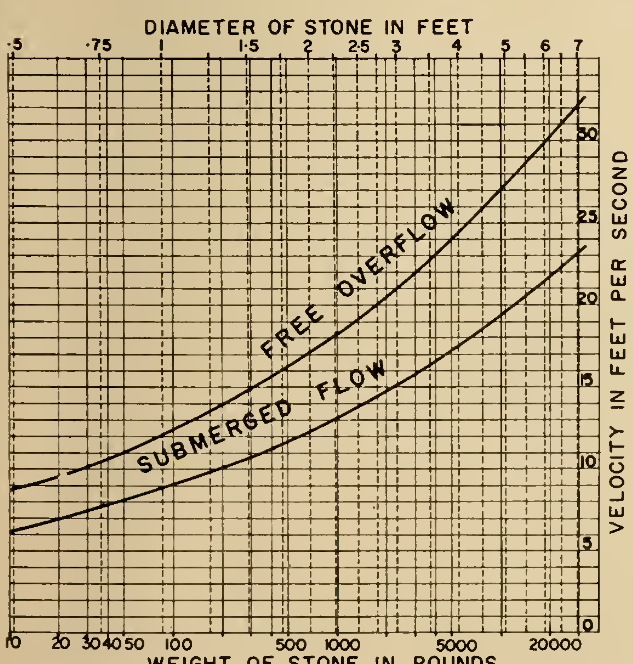
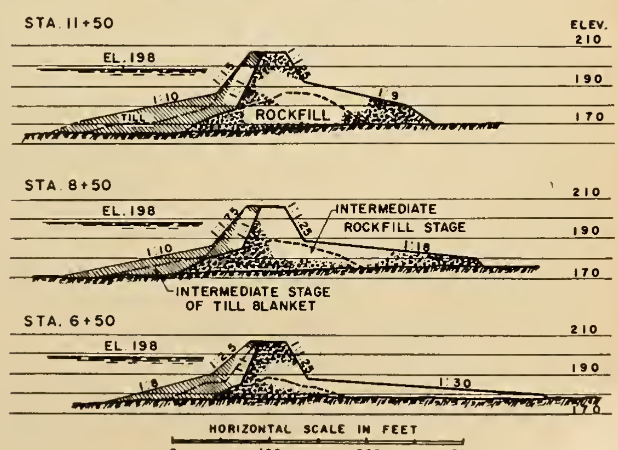


Fig. 5 (left). Critical transporting velocities and weights and sizes of stones dumped in flowing water (after S. Isbash). Specific weight of stone assumed to be 165 lb./cu. ft.

Fig. 6. Actual cross-sections of cofferdam 'E' as built. Downstream slope became flatter when construction advanced nearer closure section.



was eroded in the glacial till as well. Large rocks weighing up to 5,000 lb., dropped in this opening, were swept downstream. Finally, a few steel and timber frames were made from scrap steel beams and dropped in the gap. These frames were held in place by 1½-inch cables anchored to trees upstream from the cofferdam. After placing the frame barrier, the last 60 ft. gap was closed with quarry-run rock in a few hours, by skip and end dumping.

Construction of rockfill section of cofferdam stage 3, by truck dumping of rock. (HEPCO)

Earth Blanket Upstream

Seepage through the rockfill cofferdam was approximately 10,000 c.f.s., compared with the former flow through the north channel of 190,000 c.f.s. Sealing of the cofferdam was effected by placing an earth blanket, which reduced seepage to approximately 12 c.f.s.

Till used for the blanket was very suitable for sealing the cofferdam, as the local till consists of silt, sand, and gravel with a little clay and numerous boulders. As the rockfill was quarry-run rock containing spalls and small rock, the designed filter section between the rockfill and the earth blanket was omitted. But some gravel and small rock was placed on the upstream slope of the final closure; the rockfill here consisted mostly of large rock.

Till was dumped by trucks along the upstream face and initially took a slope 1 on 1½ for the upper 15 ft. under water, but the slope was 1 on 5 to 1 on 7 below that level. As more till was dumped to increase the thickness of the blanket and to extend it further upstream, the final slope for the upper section became about 1 on 2 and 1 on 10 for the section more than 15 ft. under water. It seems that lateral dumping along the sloping face of the rockfill accounted, mainly, for the flat slopes.

Experience Confirms Model Tests

Observations in the field at Long Sault dam and other projects substantially proved the correctness of the model tests in the laboratory by S. Isbash[1] and others regarding the stability of stones and rockfills in flowing water. It seems there are some definite stages of construction of rockfill dams or cofferdams in flowing water.

Closure gap approx. 80 ft. wide. Cableway skip is ready to drop first frame. Sweeping velocities at toe of cofferdam increased to 28 f.p.s.

Initially the profile of the dumped rockfill takes the form of an isosceles triangle with side slopes of 1 to 1.

After reaching a certain height, the downstream slope becomes elongated and the profile loses the true isosceles form. There is also a more pronounced drop in the water surface over the dam at this transition stage and the downstream water surface becomes slightly undulatory in appearance (Fig. 7).

With further dumping of stones, we reach a stage in which it is very difficult to make progress in the vertical direction as the dumped material tends to flow or roll downstream. The profile of the submerged section becomes trapezoidal in outline. The difference in elevation between the head and the tailwater also becomes larger and the tailwater surface shows marked undulations.

The dumped stones are transported noticeably in a lateral direction by the increased velocity. After reaching the downstream face, many of the stones do not remain in place, but roll along the downstream slope until reaching a stable position at a lower elevation. The length of the submerged section increases rapidly, but the accompanying increase in height is retarded. The downstream slope becomes from 1 on 5 to 1 on 10, or even flatter if the rock is fine or contains much fines. Finally, a critical stage is reached at which it is necessary to increase the size of the stones to resist displacement by the overflow. From the standpoint of hydraulics, the critical stage indicates a transition from the condition of submerged flow to the condition of free overflow over the crest and downstream slope.

It appears there are two deceiving stages during construction by dumping stones in flowing water. First, rather light stones stay in place and build up a triangle, and give the impression that no large rocks will be required to complete the cofferdam. Then comes a stage when progress in height is so small compared with the volume of rock dumped, that there appears to be no hope of completing the cofferdam.

Importance of Stone Size and Interlocking

An individual stone is affected by the overflow and percolation forces which tend to push and to roll the stone down. Resisting force, first of all, is the weight of the stone, but it is evident that shape and the mutual interlocking and sheltering action are of great importance. This interlocking effect reduces stone weight required to withstand certain velocity during the stage of "free overflow". A well graded rockfill would offer little resistance to the rolling stones. Small rock fills the voids between the large rocks and a fairly smooth pavement is obtained on which dumped rock is rather easily carried downstream. The slope of fill consisting only of very large stones has a rough surface and comparatively high resistance to rolling or sliding, but percolation flow is high and may lessen the advantages due to improved interlocking power to a certain degree.

Fig. 5 shows a chart indicating the relation between the weight of a stone and stream velocity, which was used for hydraulic calculations of cofferdam "E". This chart was suggested by S. Isbash on the basis of model tests, and it agrees with test results of other researchers. There is considerable difficulty in computing velocity and, eventually, the required stone size, as friction of the rockfill and heads cannot be accurately ascertained in advance. Further, it is very difficult to produce uniform size rock in a quarry, and is usually very expensive. Therefore, a theoretical calculation of the size of stone required to build a stable cofferdam is not a rigid solution but only an approach to estimate the possible conditions.

View of downstream slope of completed cofferdam. Note increasing width of downstream berm nearing closure gap. (HEPCO)

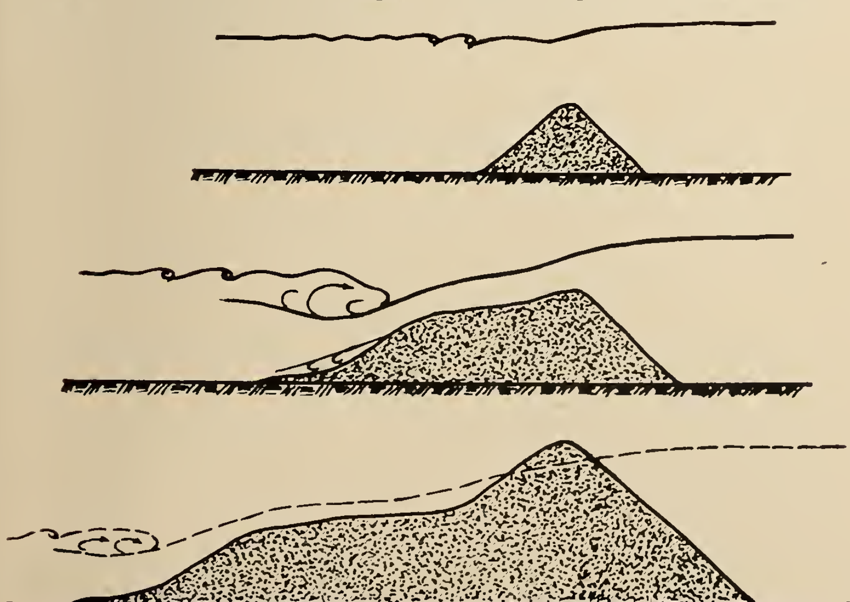
From the hydraulic standpoint, the most rational method of construction is to use only small stones at the beginning and, subsequently, to change to larger sizes for the downstream part of the cofferdam. This would give the smallest volume of rockfill, a minimum percentage of large size stones and reduced percolation flow. It is particularly important at the critical stage to ensure uniform dumping of material along the entire length of the dam. Any attempt to raise the dam at separate points increases velocities adjacent to the higher spots and results in slides of rockfill.

During construction such a slide occurred at the north end of cofferdam "E" in the deepest section (approx. 35 ft. deep) of the river. Here the tower ramp (Fig. 3) projected into the river and increased stream velocities. Ice jams interrupted dumping of rock for a couple of weeks, and during that time the rockfill was eroded almost to the river bottom. This eroded gully was in the shape of a large "V", and approximately 5,000 cu. yd. of heavy rock was required to backfill the gap to uniform height. A considerable amount of selected stones weighing 4 to 6 tons were placed in the gap.

Cofferdam Built With Steep Slopes

The actual cross-sections of cofferdam "E", as built, differed considerably from the design cross-section (Fig. 4 and 6). Smaller size rock than originally planned, containing a high percentage of fines, is the main reason for the difference. But during construction of the McNary dam on the Columbia River[2] it was proved that a rockfill cofferdam with rather steep slopes 1 on 2 can be built in swift water if the size of the rock (or concrete blocks) is right, and if construction is preceded and accompanied by a thorough hydraulic model testing.

Fig. 7. Typical construction stages of rockfill dumped in flowing water.



The Columbia River flow was between 120,000 and 150,000 c.f.s., of which 80,000 c.f.s., was discharged through a closure gap 240 ft. wide and up to 55 ft. deep. Model experiments before construction indicated maximum velocity of 15 f.p.s. at the beginning of the closure, but velocities would go as high as 28 f.p.s. over the crest, and 38 f.p.s. near the toe of the rockfill cofferdam during construction by dumping blocks and stones with a cableway.

The downstream section of the Columbia cofferdam was built of 12-ton concrete blocks, and selected 2-ton or heavier stones were placed in the upstream section (Fig. 8). The concrete blocks were formed as tetrahedrons, as this shape is the most stable in flowing water.

Extensive model testing was done before dumping commenced and a 1:24 scale model of the entire 240 ft. closure gap was built at the site of the dam. This permitted very close inspection and coordination of construction of the cofferdam.

It is interesting to note that while being built the McNary cofferdam had taken triangular and trapezoidal shapes before the crest emerged from the water (Fig. 8). One can clearly see the transition, or critical stage, when the flow changed from the submerged stage to the overflow stage.

CONCLUSIONS

Experience and model studies indicate that large rocks are required only for the downstream zone of the rockfill. A substantial part of the lower zone and upstream part of the cofferdam can be built of small or quarry-run rock.

The originally-suggested 24,000 lb. stones were certainly unnecessary for cofferdam 'E'. It seems that 5,000 lb. stones were the maximum size required to build an adequate downstream barrier for the cofferdam with a steep downstream slope. Of course, the heavy rock zone could not be mixed with fine rock as such mixture reduces the interlocking effect of the stones. The heavy rock zone should be shaped as indicated in Fig. 8; the barrier zone in Fig. 4 does not correspond to the natural shape formed by the overflowing water. The rock could be smaller than the maximum size above and below the critical zone of the barrier, but a detailed division in the vertical zones is not recommended as it is very difficult to maintain during the dumping operation, and the advance hydraulic computation is not accurate enough to establish precise limits.

Rockfill will take a much flatter downstream slope if only unsorted quarry-run rock is used. The success of building a cofferdam by end dumping of rock only depends on the feasibility of diverting the river flow gradually and quickly, and on the velocity of the flow during the final closure stage.

Construction of cofferdam "E", and the diversion of the large flow of 200,000 c.f.s., were very successful. The contractor followed the scheme suggested by the designing engineers, but made changes and alterations to suit the available material and changing working conditions.

End dumping by trucks could place the rock five times as fast as skip dumping, although placing of rock only by cableway skip would have required less material. Approximately 205,000 cu. yd. of rock was used to build the rockfill section. The estimated quantity for the designed cross-section with slopes 1 on 2 was 115,000 cu. yd., including 40,000 cu. yd. of selected heavy rock (up to 7 tons weight), which could be produced at the available quarry only at a very high cost. The contractor used surplus rock from cut "F" and quarry-run rock which was considerably less expensive than any selected rock.

Cofferdam "E" was completed in April 1957, in time for the second stage construction of Long Sault dam, although early in February a heavy ice jam in cut "F" forced the interruption of construction of cofferdam "E" for five weeks.

It took twelve working weeks to complete the rockfill section and a further three weeks to place the upstream blanket.

It appears that cofferdam "E" was one of the most economical major cofferdams on the project.

ACKNOWLEDGEMENTS

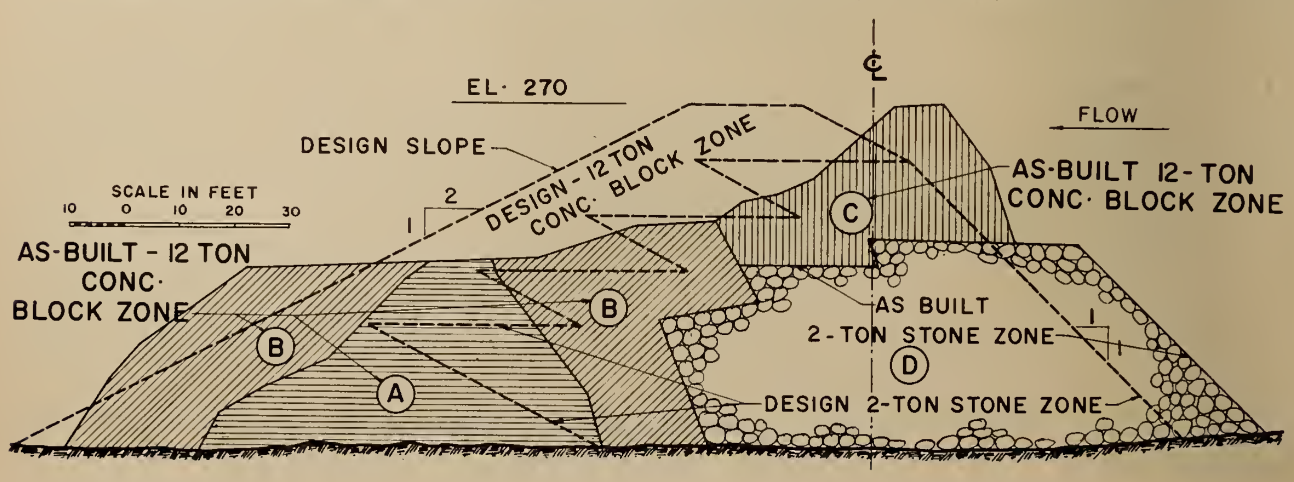
Uhl, Hall & Rich, Boston, Mass., were engineers for The Power Authority of the State of New York (PASNY). Sequence of construction operations was set up by the Hydraulic Laboratory of Hydro-Electric Power Commission of Ontario (HEPCO).

The author is indebted to Mr. R. Connor, hydr. engineer of U.H. & R., and Mr. R. Haney, field engineer of Walsh Construction Corporation, who reviewed the author's observations and compared them with their experiences.

REFERENCES

1. S. Isbash. Construction of dams by dumping stones into flowing water. Leningrad, 1932.
2. Col. W. Whipple; Taming the Columbia River at McNary Dam. Engineering News Record, June, 1950. Also: McNary Dam Diversion's toughest part. Engineering News Record, Dec. 14, 1950.

Fig. 8. Design and actual 'as-built' cross-section of rockfill cofferdam for McNary Dam on Columbia River. Construction sequence: first stage, zone A; second stage, zones B and D; third stage, zone C.



The St. Lawrence Power Project

Electrical Features of the Robert H. Saunders-St. Lawrence Generating Station

R. M. Fullerton

Project Engineer, Generating Stations, Hydro-Electric Power Commission of Ontario

The Robert H. Saunders-St. Lawrence station is the Canadian half of the joint Canadian and United States powerhouse at the International Rapids section of the St. Lawrence River. This paper describes the installation and electrical equipment.

WHILE CONTROL structures, dyking, channel improvement and rehabilitation associated with the flooding of the headpond area were all major considerations in developing power from the International Rapids section of the St. Lawrence River, the focal point and largest single feature of the project was located some two miles west of Cornwall. There, the Canadian and United States' powerhouses merge at the international boundary, forming a continuous structure with an overall length of 3,300 feet and having a maximum height of 162 feet above foundation.

The powerhouses, which themselves serve as gravity dams, will contain 32 generators, 16 in each powerhouse, with a combined installed capacity of 1,640,000 kilowatts. Uniformity of design was maintained with regard to the external features for aesthetic and engineering reasons, and while the two participating agencies, Ontario Hydro and the Power Authority of the State of New York, maintained the closest liaison during the design and construction period, the electrical and mechanical arrangements in the two powerhouses differ considerably.

The main electrical connections for Ontario Hydro's Robert H. Saunders-St. Lawrence Generating Station are illustrated by Fig. 1. This shows the four unit arrangement adopted, each group consisting of four 60,000 kva. generators with their associated low-voltage switching, 258,000 kva. step-up transformer bank, and 230 kv. transmission circuit to the St. Lawrence transformer station, situated about two miles distant. At this location the output of the station is fed into the 230 kv. and 115 kv. Ontario Hydro systems, as well as to certain 44 kv. circuits for transmission to neighbouring communities.

Generators

The generators were supplied by two Canadian manufacturers, each supplying eight. In each group of four generators, two of one make are connected to one low-voltage winding of the transformer bank, and two of the other are connected to the remaining low-voltage winding. Each generator is rated 60,000 kva., 13.8 kv., 3 phase, 60 cycles, 94.7 r.p.m., 0.95 power factor. Class B insulation is used throughout and the machines are designed to deliver their rated output without exceeding the temperature rise for Class A insulation, and to operate at 15% above that rating without exceeding the temperature limits for Class B insulation. Both manufacturers have located the thrust bearing below the rotor, using the edge of the thrust block as a journal for the single guide bearing. High pressure oil lift is provided for use during starting of the generators.

Concrete walls below the powerhouse deck form the generator enclosure (Fig. 2). Access for major maintenance work is provided through motor-operated hatches, permitting the 300-ton gantry crane to lift heavy parts and transport them to the erection bay. Vertical lift doors on the two sides of this crane can be lowered to provide a heated enclosure for work on a generator. Minor maintenance or repairs may be done without opening the hatches. A two-ton capacity monorail hoist for handling parts is provided to facilitate such work.

Cooling of the generators is accomplished by passing the ventilating air through air-to-water heat exchangers. One of the manufacturers has located the exchangers in the corners of the concrete enclosure. The other has located them circumferentially on the generator frame. Provision has been made to bleed-off warm air for powerhouse heating. The generators ventilation system is separated from the turbine pit by baffles located on the lower generator bearing bracket.

Copper-constantan thermocouples are provided to measure the temperature of turbine and generator bearings, stator iron, incoming cooling water, outgoing water from each cooler, heated air leaving the stator iron, and cooled air entering the rotor. The temperature of the field is measured by a temperature simulator developed by the Research Division of Ontario Hydro.

Carbon dioxide fire protection is provided for the generators. This protection may be actuated by the operation of the split phase relay protection, the operation of thermostats located in the machine, or from break-glass stations. Sprinkler rings, to which water may be applied by manually operated valves, are provided.

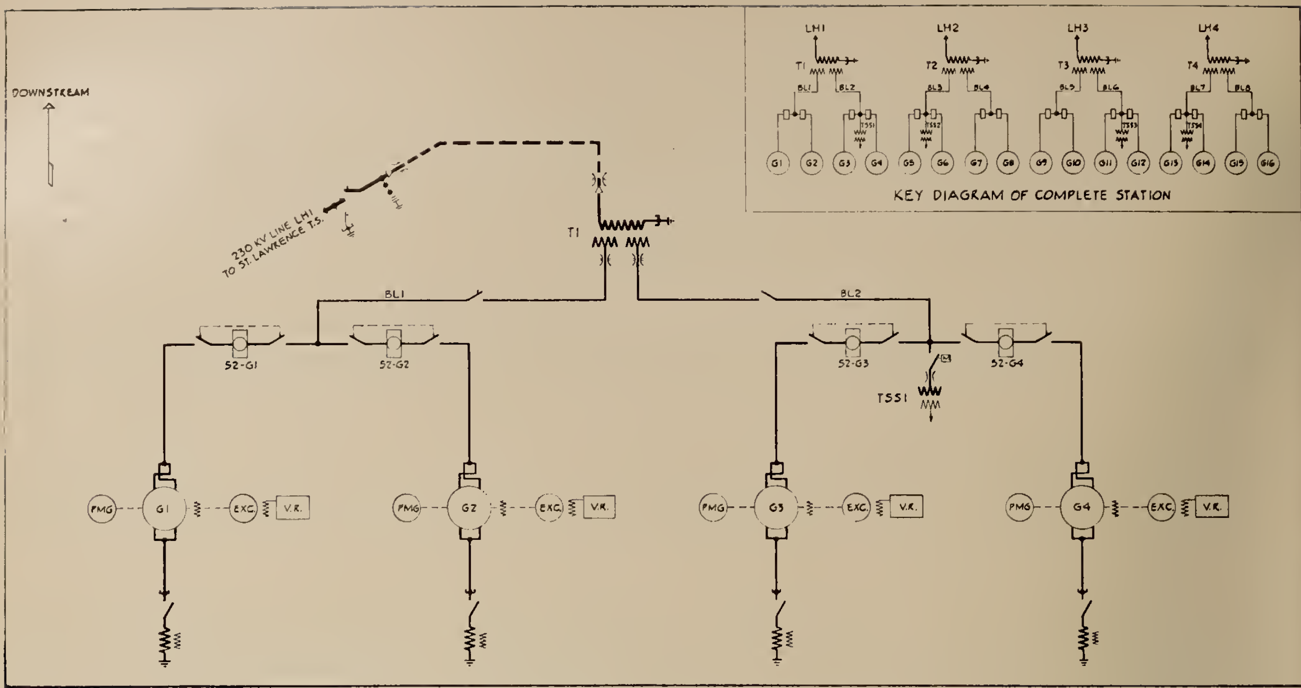


Fig. 1. Main schematic (one-line) diagram.

The generator neutral is grounded through the high-voltage winding of a 13.8 kv./115-230 volts distribution type transformer. The low-voltage winding of this transformer is loaded with a resistor designed to draw sufficient current so that the kilowatts consumed in the resistor are approximately equal to the kilovars of the capacitance current between the generator winding, generator leads, power transformer low-voltage winding, etc. and the ground.

A current relay is used on the secondary winding of this transformer to detect 13.8 kv. ground faults.

Voltage Regulator Equipment

Both generator manufacturers supplied automatic highspeed continuously acting voltage regulators of the static type, one using a magnetic amplifier and the other a rotating amplifier. Cross-current compensation is provided and provision is made for the later addition of line-drop compensation.

Isolated Phase Bus

The connections from the generator terminals to the low voltage switchgear and from the switchgear to the transformer low-voltage terminals are made by means of isolated-phase bus. Between the generator terminals and the 14.4 kv. bus, 3,000 ampere bus is used. The connection between the 14.4 kv. bus and the transformer delta is 6,000 amp. From the delta connections to the transformer terminals 3,500 amp. bus is used. Isolated-phase bus, 3,000 amp. capacity, is also used between the 14.4 kv. bus and the high-voltage terminals of the 3,000 kva. station service transformers. Both the conductor and housing of the isolated-phase bus are of aluminium.

L.V. Switchgear

The metal enclosed 14.4 kv. switchgear comprises eight structures each housing two 3,500 amp., 2,000,000 kva. air-blast circuit breakers, the necessary potential and current transformers, and bus connections for two generators. Four of the structures include a tap for a 3,000 kva. station service transformer.

Main Power Transformers

The four main step-up transformer banks each consist of three 86,000 kva., 13.5-13.5/132 kv., 900 kv. BIL, 3-winding forced-oil water-cooled single-phase transformers, connected delta-delta/grounded Y to give a bank ratio of 13.5-13.5/230 kv. One full-capacity 5% tap is provided above 230 kv. The capacity of the transformers was chosen so that the generators could operate at 15% over their rating without seriously overloading the transformers. Consideration was given to using three-phase units, but the economic advantage offered was outweighed by transportation problems. Tenders were obtained for various types of cooling and forced-oil water cooled units were chosen on the basis of lowest installed cost. Fire protection is provided by an automatic deluge system, actuated by rate of rise devices.

Because of the length of the powerhouse and the amount of power involved, it was not physically or economically feasible to transmit the power to the shore at generator voltage. The transformers were therefore located on the downstream deck of the powerhouse structure, making the low voltage connections as short as practicable.

High Voltage Cable

With the decision made to locate the main power transformers on the downstream deck of the powerhouse, considerable study was given to the problem of getting the high voltage circuits to the shore. Because of the length of the power-house and the angle at which it sits with respect to the shore, transmission of the power by overhead circuits presented considerable difficulty. A number of schemes using this method were studied and offered some economic advantages over. the use of 230 kv. cable. They were, however, undesirable from the aesthetic, operating, and maintenance points of view and it was decided to use cable.

An oil-filled cable with a single copper conductor 960 MCM in area was selected. Each circuit is designed to carry continuously the output of four generators operating at 15% above their rating with the ambient temperature at 40°C. The cables are located in ventilated tunnels under the downstream deck of the powerhouse and they are connected to the overhead lines at a terminal structure located just south of the 14-foot navigation canal.

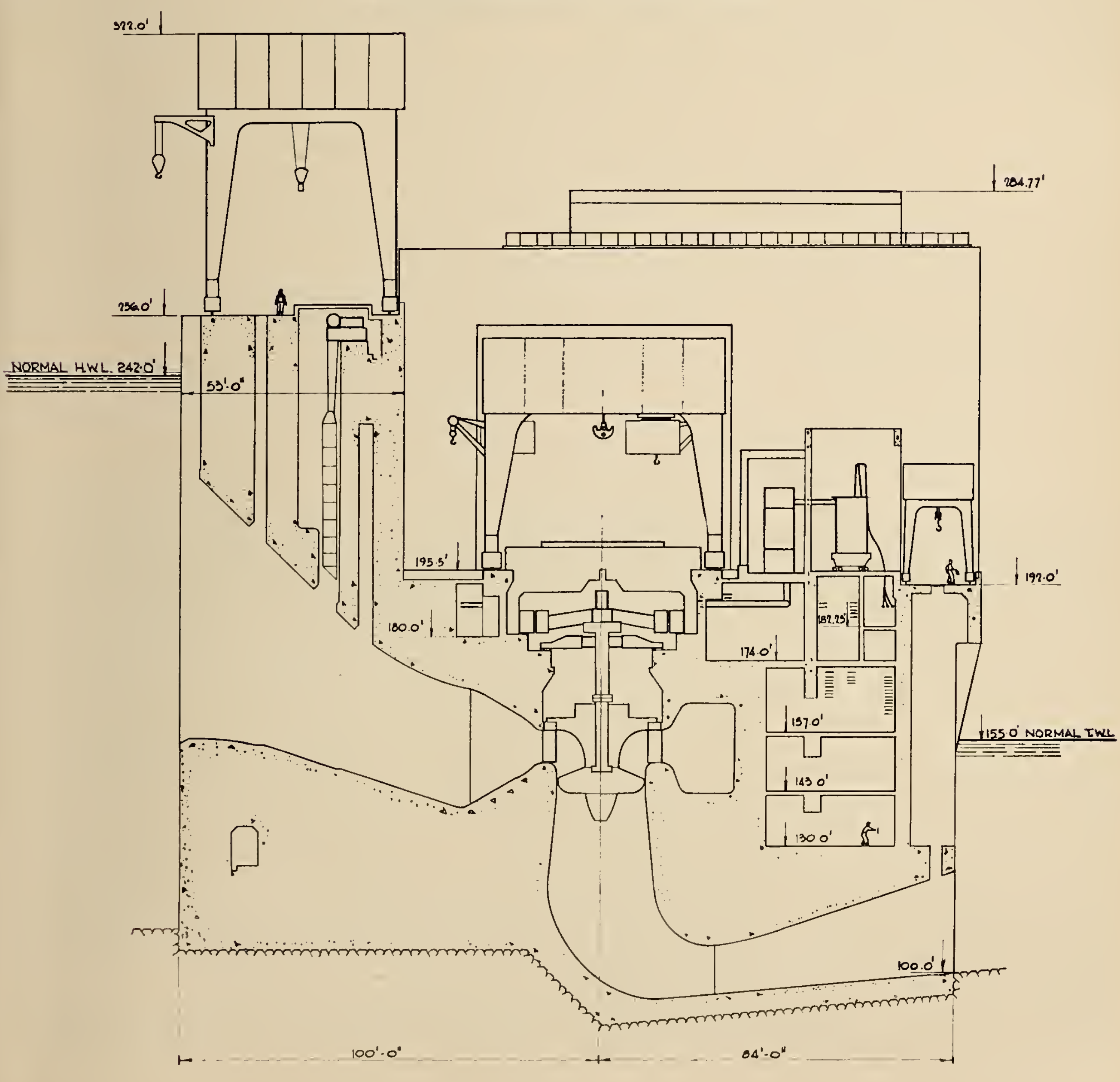
Control and Metering

All generators and associated equipment are controlled from a central control room in the administration building located at the shore end of the powerhouse structure. Operating controls, dummy bus and indicating lights are mounted on a benchboard 13 feet in length. The vertical instrument switchboard is of a horseshoe shape, with those meters essential to the operation of the plant mounted on a 15 feet long section of switchboard, so located that it is immediately in front of the operator when standing at the benchboard and is readily visible from his desk. Graphic meters, annunciators, etcetera, are mounted on switchboards to the right and left of the operator. Instruments for recording historical data are mounted on a switchboard parallel to, and behind, part of the main switch-board. Those control facilities and meters essential to the operation of the plant are duplicated on control switchboards located on the operating floor adjacent to the generators. These facilities are grouped so that one switchboard serves four generators. The switchboards also incorporate the protective relays associated with the four generators and step up transformer bank concerned.

To reduce the number, size and installed cost of control cables between equipment and the control room, 48 volts d.c. is used to energize interposing relays to apply 125 volts d.c. to operate the equipment. Similarly 5/0.5 amp. auxiliary current transformers are used on all current circuits for remote metering.

Four 60-cell 320-ampere-hour lead-

Fig. 2. Typical cross-section of the powerhouse.



acid batteries are provided to supply the 125 volts d.c. requirements for the station. Each battery normally supplies the control requirements for four generators. Emergency connections are provided so that loads can be paralleled in the event of the failure of a battery. The 48 volts d.c. control requirements are supplied by two 24-cell lead-acid batteries. One of these is normally the operating battery with the other serving as stand-by. The function of the two batteries is alternated at regular intervals. Rectifier chargers are used on all batteries.

Automatic 'start-stop' control is provided for all generators; i.e., the generator is started, brought up to speed and synchronized automatically upon the operation of the appropriate key. The machine is then loaded manually. Similarly, when shutting a machine down, it is unloaded manually and the appropriate key operated. The generator then shuts down automatically without any further attention from the operator.

Automatic load and frequency control provides a means for regulating the 16 generating units on sustained and/or fringe control from a signal transmitted over power-line carrier from the power supervisor's office in Toronto. Means are also provided for distributing the regulating burden among the 16 generators on the basis of equal per cent participation by each unit. Station total kilowatts and

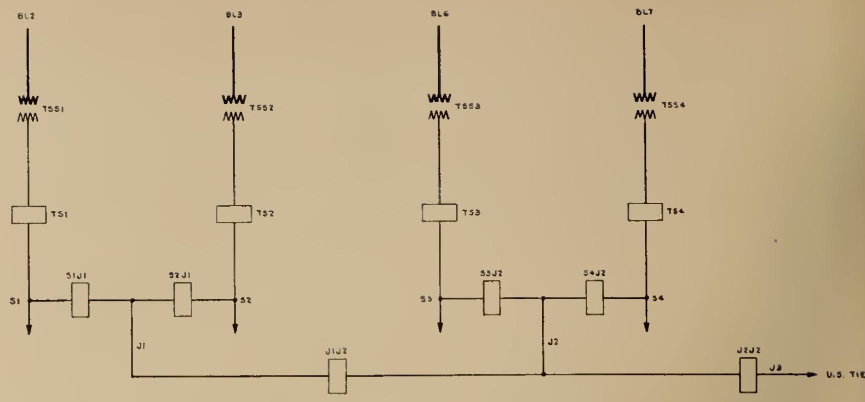


Fig. 3. Station service key diagram.

kilovars are telemetered to the power supervisor's office.

Those temperatures which give a picture of the proper functioning of the elements of the plant are measured by copper-constantan thermocouples. The output of these thermocouples is transmitted to instruments centralized at two locations on the operating floor, one between generators 4 and 5 and one between generators 13 and 14. Each location accommodates the instruments measuring the temperatures associated with eight generators. The following temperatures are continually monitored:

Generator thrust bearings.
Generator and turbine guide bearings.
Generator stator iron.
Generator incoming and outgoing air.
Generator field temperature.
Transformer oil temperature.

In general, all instruments are normally indicating; they automatically start recording and sound an alarm when any temperature exceeds the predetermined maximum setting. Recording may also be started by the operation of a manual switch.

Protection

The relay protection provided at this station is in accordance with modern accepted practice for large generating stations. Since no high-voltage circuit-breakers are provided at the generating station end of the transmission circuits to the St. Lawrence transformer station, remote tripping circuits are provided to operate 230 kv. circuit-breakers at the transformer station end of the lines for

Fig. 4. This is how the powerhouse area appeared from the air shortly after the upstream cofferdam was breached, 1 July 1958, by 30 tons of high explosive. The Canadian mainland is in the background, the adjoining powerhouses are shown centre, and Barnhart Island left. The downstream cofferdam, partly removed, was breached 31 March 1958.

transformer, line, or bus faults.

The main protection for the 230 kv. circuits to the St. Lawrence transformer station is provided by wire-pilot relays at both ends of the circuits. Back-up protection at the transformer station end is provided by directional over-current relays for phase and ground faults. At the generating station end the transformer back-up protection serves also as back-up protection for the 230 kv. circuits.

Differential protection, phase and ground back-up protection, and gas-detector relays are provided for the four 258 Mva. transformer banks. The 14.4 kv. bus is protected by differential and ground relays. Induction overcurrent relays provide protection for the 3,000 kva. station service transformers.

The sixteen 60,000 kva. generators are protected by differential, split-phase, phase current balance, stator ground, and phase back-up relay protection. In addition, devices used to detect mechanical failures will operate to shut down the generator affected. These include: low governor oil pressure; overspeed; incomplete starting sequence; high thrust bearing temperature.

A complete system of annunciators and alarms is provided to monitor the above protections and other abnormal conditions.

Fig. 5. This close-up view of the headworks of the generating station was taken shortly after the headpond was flooded. Debris visible in the forebay was flushed down the channel when a cofferdam was breached some 2½ miles upstream from the powerhouse.

Station Service

Power for the operation of the station auxiliaries is supplied by four 3,000 kva., 3-phase, 13.8 kv.-600 volts self-cooled transformers. These transformers are equipped with ± 10% underload tap changers. A station service transformer connection is taken from the 14.4 kv. bus of generators 3 and 4, 5 and 6, 11 and 12, and 13 and 14. Each transformer normally supplies the service requirements for four generators. The generators supplied by any station service transformer are alternated with those supplied by an adjacent station service transformer. For example No. 1 transformer supplies generators 1, 3, 5 and 7, while No. 2 supplies generators 2, 4, 6 and 8. Since the governor hydraulic systems of odd and even numbered turbines are interconnected, loss of one station service transformer will not result in the shut-down of the four generators supplied by that transformer. Neither will it result in a large area of the station being without illumination. In addition, the 600 volts switching arrangement (Fig. 3) is such that the load of any station service transformer can be paralleled with that of any other. The capacity of the transformers was chosen so that one transformer can, in an emergency, carry the essential services for eight units.

An emergency tie with the 480 volt station service system of the United States powerhouse is provided by means of a 500 kva. 480/600 volts autotransformer. This tie is of sufficient capacity to provide start-up

Fig. 6. A section of the powerhouse with part of the Cornwall dyke stretching into the background. The 3½-mile long dyke, which helps to retain the headpond, involved placing and compacting more than 5 million cubic yards of glacial till. (all photos: Ontario Hydro.)

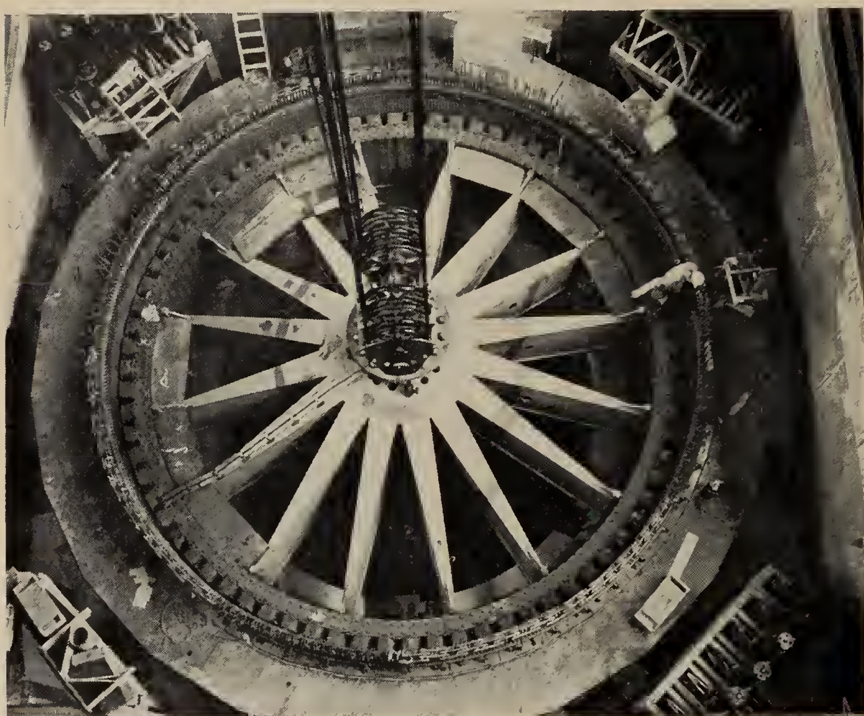
power in the event of a complete shut-down of either the American or Canadian powerhouse.

Lighting

The station lighting system operates at 208/120 volts, 4-wire. The main control room is lighted by fluorescent fixtures mounted above a translucent plexiglass ceiling; a type of installation successfully used at the Commission's Otto Holden and Sir Adam Beck-Niagara No. 2 generating stations. This installation is designed to give an average initial illumination of 150 foot candles on a horizontal plane 30 inches above the floor, and an average initial illumination of 70 foot candles on vertical surfaces 66 inches above the floor. The operating level is expected to be approximately 115 foot candles and 50 foot candles respectively. All other operating and maintenance areas are lighted by fluorescent fixtures. Incandescent lighting is used in all other areas of the powerhouse. Exterior lighting for the Canadian and American powerhouses was closely co-ordinated to provide uniformity of appearance. The headworks structure is illuminated by mercury vapour floodlights and the generator deck by recessed incandescent fixtures mounted on 40 foot centres on each side of the deck.

Failure of the a.c. supply operates contactors to put into service emergency lighting supplied from a 125 volt control battery. A separate battery is provided for the supply of emergency lighting to the administration building.

Fig. 7. First power from the Robert H. Saunders-St. Lawrence generating station was made available to the system 5 July 1958, when unit No. 2. was placed in service. The remaining 15 units will be brought into operation progressively until late 1959. This photograph shows the rotor being installed in unit No. 4.



Heating

The operating area of the powerhouse is heated by air extracted from the generator ventilating circuits and circulated through the area. Heat extracted from generator and transformer cooling water by means of heat pumps is utilized for the heating of the administration building. Areas not readily accessible for heating by either of these methods are heated by electric space heaters.

Because of the semi-outdoor type of construction used, it was anticipated that, during the winter, large quantities of snow would accumulate on the powerhouse deck, interfering with normal traffic and with major maintenance or repairs which might have to be carried out during the winter months. After investigating several methods of snow removal, it was decided to use electrical heating of the concrete deck slab for this purpose. The installation consists of copper - sheathed mineral - insulated cables with a resistance wire core, embedded in the concrete slab. Experimental tests indicate that the installation is effective for the purpose intended.

The St. Lawrence Transformer Station

A. Matheson, M.E.I.C.

Project Engineer, Stations Department, Hydro-Electric Power Commission of Ontario

The St. Lawrence transformer station is situated about two miles north of the Robert H. Saunders-St. Lawrence powerhouse. Power is also received from the Beauharnois generating station. This paper describes the transformer installation.

THE St. Lawrence Transformer Station is a key component in the Ontario Hydro system for the transmission of power to Toronto and Western Ontario. It receives the output of the new Robert H. Saunders-St. Lawrence Generating Station as well as power from the Beauharnois Generating Station. It has replaced the smaller Cornwall Transformer Station, now dismantled, which supplied 44 kv. power in that area. Tie lines to the United States from this station connect with the system of the Power Authority of the State of New York. The station has been designed to permit its expansion to an ultimate capacity consisting of four autotransformers, four stepdown transformers, two regulating transformers, seventeen 230 kv. lines, sixteen 115 kv. lines, and twelve 44 kv. feeders.

Site

The station site covers an area of 25 acres within the new Cornwall city limits and it is situated about two miles north of the powerhouse. The soil consists of hard-packed glacial till, containing a large quantity of boulders. A spur from the Canadian National Railway enters the west end of the station, so that heavy equipment can be brought in by rail.

230 kv. Switchyard

Airblast circuit breakers with an interrupting capacity of 15,000 mva. are installed in the 230 kv. switchyard. The bus arrangement features 1⅓ breakers per element and 14 breakers are scheduled for service by 1959. The switch structures and equipment are designed for 900 kv. BIL, with 196 kv. insulation class. Each breaker is equipped with two motor-operated isolating switches.

Each 230 kv. outgoing line terminal is equipped with a gang motor-operated 1,200 amp. disconnecting switch with three-pole manually-operated grounding switch, three potential coupling capacitors, power line carrier and communication equipment.

115 kv. Switchyard

Airblast circuit breakers of a "dead" tank design having an interrupting capacity of 5,000 mva. have been installed. A total of nine will be in service by 1959. The bus arrangement gives 1½ breakers per element. The design is for 550 kv. BIL with 115 kv. insulation class, except disconnecting switches, which are 138 kv. The outgoing lines are equipped with potential transformers.

44 kv. Switchyard

Conventional oil circuit breakers with an interrupting capacity of 1,000 mva. have been installed. These may be by-passed for maintenance. Six breakers are now in service.

Structures

All switchyard structures are hot-dipped galvanized steel, 600 tons of structures having been erected to date. They are supported on concrete piers, resting on spread footings designed for three tons per square foot soil pressure.

Transformers

By 1959, there will be in service two 115 mva., 230-115-13 kv. autotransformers; two 25/41 mva., 115-44 kv. stepdown transformers, and one regulating transformer, installed in the 230 kv. tie line to the Power Authority of the State of New York. This regulating transformer will have a capacity of 250 mva. with an operating range of 248/230 kv. and is equipped with an "on load" tap changer. It is protected by lightning arresters. Cascade type potential transformers and high accuracy current transformers will be installed for metering on the tie line.

Station Service

The low voltage power for the station auxiliaries, compressor plant, electrical heating and lighting is provided by two outdoor, three phase, 1,500 kva. each, 60 cycle, 44 kv.-600 volts station service transformers located in the 44 kv. switching yard. These transformers, connected to 44 kv. buses, supply outdoor metalclad switchgear equipped with main air-circuit breakers, distribution panelboard and cable terminals for the outgoing 600-volt feeders. Four outdoor load centres conveniently located on the station site are installed and are equipped with automatic changeover switches, distribution cabinet, local 600 volt-120/208 volt transformer and its protection. These load centres supply service power for transformers and other auxiliaries and to each of the station buildings.

The direct current for station controls and protections is provided by two 250 volts, 116 cell lead acid storage batteries, 210 ampere-hours and 300 ampere-hours respectively, which are installed in the battery room in the control building basement. Two selenium type battery charging rectifiers, each rated 60 ampere, are provided to maintain the capacity of the storage batteries.

Relaying

Relaying equipment is located in three relay buildings, two in the 230 kv. area and one in the 115 kv. area. Long lines at 230 kv. have directional comparison relays with power line carrier for the high speed protection. The phase relays have a timer which will open the circuit breakers whenever a fault occurs at the remote end of the line while the carrier equipment is out of service. A directional overcurrent relay is used as a backup protection for phase-to-ground faults. An overcurrent line test protection for phase and ground currents is put in service automatically whenever the line is being energized after being off potential for five seconds or more. The circuit breakers for these lines can be reclosed without supervision within half a second from the time the fault occurred by single shot reclosing relays.

Lines at 230 kv., which connect to the generating station two miles away, have pilot wire relays for the high speed protection. Induction overcurrent relays with directional control are used as backup protection against phase and ground faults. Circuit breakers for these lines will be reclosed by single shot reclosing relays with high speed undervoltage supervision with a delay of less than one second from the time the fault occurred. Since the transformers in the generating station at the remote end of each line do not have a 230 kv. circuit breaker, direct current is used on pairs of control wires between the two stations for tripping the breakers at the transformer station. All the long and short 230 kv. lines will have definite time protections for phase and ground faults which will trip the same breakers on the second time step. The contacts of the timers for the first time step will be used in the 1959 stage for opening the 230 kv. bus tie breakers and separating the station into halves. This operation will reduce the equipment removed from service if a circuit breaker in the station fails to open, or when some other equipment fails and is not removed by a high speed protection.

Transformer backup protections will operate timers giving two steps in the tripping sequence. The station would be separated into halves on the first step because both auto-transformers are on the same half of the station. The contacts for the second step will be used to open the low voltage breakers earlier than the others in an attempt to clear a low voltage fault without any further disturbance to the 230 kv. connections in the stations.

Other protections in this transformer station have standard circuits which are not described.

Control Building

The control building is centrally located in the station. It is a one-storey brick building and has a 45-foot by 60-foot control room. A "honeycomb" aluminum ceiling with fluorescent lighting above the "honeycomb" provides a high level of illumination throughout the control room.

The station is controlled from a benchboard, which is installed in an arc facing the operators. All control devices and wiring are suitable for use on 250 volts. d.c. Each control point consists of a telephone type lever key, two indicating lamps and a suitable escutcheon plate. The mimic bus consists of ⅛-inch thick plexiglass attached with concealed fasteners.

Two enclosed type indicating meter boards are installed, one for the 230 kv. and the other for the 115/44 kv. areas. Meters supplied consist of ammeters, indicating watt and varmeters, voltmeters and voltmeter switches, reclosing selector switches, ground detecting voltmeters, synchronizing equipment, and transformer tap changer position indicators.

The recording instrument switchboard is a duplex type, with hinged doors and locks at each end. Metering instruments for the 230 kv. PASNY tie line and for the 115 kv. line to Massena are mounted on these boards.

Fig. 1. Aerial view of the St. Lawrence transformer station. The 230 kv. switchyard is at left, the existing 115 kv. area right, and the 44 kv. facilities and part of the control building in the foreground. The terminal towers of the transmission lines from the St. Lawrence generating station are visible, upper right.

Megawatt and megavar electronic indicating and recording station totalizing meters with impulse transmitting contacts for telemetering are installed. Similar meters without the telemetering contacts are supplied for transformer load totalizing. Recording voltmeters and frequency meters for the various voltage levels are provided.

The annunciator consists of a cabinet mounted above the 230 kv. indicating instrument board. Trip features give visual and bell alarms, while sustained alarm features give visual and buzzer alarms. Illuminated transluscent windows with a total of 250 trip and 150 sustained alarm features are provided. Relays are the plug-in type with dust covers.

Control cables are carried from the equipment being controlled to the relay and control buildings in buried concrete trenches from two to four feet wide. The individual layers of cables are carried on galvanized supports in the trenches. The trenches are covered with light weight precast concrete covers. Parallel lines of tile provide drainage.

Air Supply for Airblast Breakers

The most interesting mechanical feature of this job is the high pressure compressed air supply to the 115 kv. and 230 kv. circuit breakers. This is divided into two systems; compression and storage at 600 psig and distribution at 350 psig. The compressors are package-type comprising 25 horsepower Vee-belt electric motor drive, liquid-to-air radiator, air-to-air aftercooler, cooling air fan and liquid coolant circulating pump. Outside air is used for cooling, automatically damper throttled, to prevent condensate freezing in winter. The air and water temperature controls are pneumatic, operating at 15 psig through pressure reducing valves from the discharge of each compressor, thus being operative only when a compressor is running. The compressor building is designed to accommodate five compressors of 50 cubic feet free air per minute capacity, with three currently installed. Space is provided at the north end of the building for twelve 60 cubic foot capacity vertical receivers, 36 inches in diameter by 11 feet high, with six installed to date. Each compressor has a full complement of auxiliaries, alarms and lockout, aftercooler trap, cyclone oil and water separator with automatic trap, ceramic filter, dual-tower activated alumina dryer with electric reactivation, the necessary stop, check, by-pass and drain valves, thermometers, relief-valves, pressure gauges and pressure switches. All equipment and piping except the compressors and after-coolers are 300 pound WSP class (600 pound WOG). The compressors and after-coolers are adaptable to operation at 1000 psig. The three types of airblast circuit breakers installed operate at pressures of 250 psig, 325 psig, and 350 psig. Each breaker in the first two categories is equipped with a pressure reducing valve (the supply is at 350 psig). The switchyard air piping is laid horizontally on each wall of a buried cable trench on rollers just beneath the trench covers. It is thus always available for inspection, and isolating valves are convenient. Each side of the dual system is capable of handling the total breaker requirements alone. The yard pressure is automatically maintained by pressure reducing valves. By means of fully valved ring manifolds, any combination of compressors, receivers and switchyard circuits can be selected to suit operating conditions. The activated alumina reduces the moisture content of the air such that its dew-point is always at least 50° F. below ambient in the receivers. The reduction to 350 psig lowers it still further and hence drainage and freezing is not a problem in the distribution lines.

Fig. 2. Close-up view during construction of the 230 kv. switchyard at the St. Lawrence transformer station. The airblast circuit breakers are shown, left, parallel with the disconnecting switches. (*Ontario Hydro photos.*)

Maintenance

Transformers can be moved from their pockets to the maintenance building by a transfer truck. They can then be moved into the building by being transferred to a cross transfer truck. The heaviest transformer has a shipping weight of 105 tons; 169 tons when filled with oil.

The maintenance building has a high erection bay, with structural steel columns supporting a metal roofdeck, and a 50-ton travelling electric crane. The upper walls of the erection bay are of insulated aluminum panels, and there is a vertical lift motor-operated entrance door 32 feet wide by 34 feet high. The crane is of sufficient capacity to handle heavy components of large transformers, and also complete transformers from smaller stations in the region that are sent to St. Lawrence Transformer Station for repairs.

Roads are provided for equipment maintenance to all parts of the station, with weeping tile under-drainage along the edges of gravel roads and curbs and catch basins along the paved roads.

A permanent insulating oil handling system for the transformers, regulators, etc., is installed. It consists of a building, two 40 i.g.m. blotter type filter presses, outdoor steel storage tanks totalling 37,700 imperial gallon capacity, and some 1,900 feet of buried, two-, three-, and four-inch steel pipe line. The buried pipe is protected from corrosion by wrappings and protective compound.

Design of 230 kv. Transmission Lines

N. J. McMurtrie,

Senior Design Engineer, Transmission Department, Hydro-Electric Power Commission of Ontario

THE 230 KV. transmission lines associated with the St. Lawrence Power Project provide an interesting comparison in the application of light towers versus regular weight towers. By far the greater portion of the transmission scheme for this project utilizes towers which are much lighter than those normally employed. Substantial cost reductions have been achieved with the extensive application of lighter designs, and the use of longer spans, shallower footings, and a newly designed conductor. Heavier towers have been used, however, in those places where the greater structural security was considered worthwhile.

Figure 1 illustrates the outline and dimensions of the four types of suspension towers, both single circuit and double circuit, which were used on the St. Lawrence 230 kv. transmission lines. Table I gives some application data regarding these towers. In all cases, the conductor diameter and final loaded tension were the same: 1.34 inches and 15,000 lb. respectively. The type W1 and type X1 are the lighter tower designs and the St. Lawrence type and 1951 type are the heavier or regular tower designs. (The word regular is used since these heavier towers represent the usual design practice on transmission lines up to this time.)

The major portion of the new 230 kv. transmission lines involves the lighter tower designs, type W1 and type X1. These are employed to carry the St. Lawrence power from the transformer station into the existing Southern Ontario System. This required the construction of 138 miles of single circuit (type W1) and 116 miles of double circuit (type X1) transmission lines. These lines extend generally west and north from the project area near Cornwall.

The heavier tower designs were used in the immediate vicinity of the project. Four single circuit lines (St. Lawrence type) each 2.2 miles in length, carry the power from the powerhouse to the transformer station. A double circuit transmission line (1951 type), 2.6 miles in length, connects the transformer station to the 230 kv. lines on the United States side of the river. Special high towers (335 ft.) were used on this latter line at the point where it crosses the river with a 3,300 ft. span. The crossing towers, which were designed to a specially high structural security, are not included in this comparison.

Most of the transmission scheme of the St. Lawrence power project uses towers which are much lighter than those generally employed. This paper describes the design of the towers and compares the various types and the associated equipment. A considerable saving in the cost of the line has been achieved.

Structural Design Loadings

Since the essential difference between these light and heavy tower designs is in their structural design loadings (or design assumptions, as they are sometimes called), it would be well to say a few words on this subject before proceeding with the comparison of the towers. The weight of a tower and the size of its foundation is governed mostly by the structural load for which it is designed. Since the most severe load encountered in practice is usually a combination of wind pressure and ice, acting on the conductor, the design load is expressed in these terms. It consists of a vertical load of ice-covered conductors, a transverse load of wind pressure, plus a longitudinal unbalance in conductor tension such as might be caused by a broken conductor.

Until recently, Ontario Hydro, along with most of the Canadian industry, has been using, as a design load, ½-inch radial thickness of ice on the conductors, plus a wind pressure of 8 lb. per square foot. Combined with this load is an unbalanced tension in one conductor equal to the final tension under these conditions of ice and wind (15,000 lb. for the St. Lawrence lines). This load, or its equivalent, is the basis for the design of the St. Lawrence type and the 1951 type towers.

For most of the St. Lawrence transmission lines, however, the design load has been reduced to either (*a*) or (*b*) below, whichever is greater:

(*a*) ¾ inch radial thickness of ice on the conductors, plus a wind pressure of 3 lb. per square foot;

(*b*) a wind pressure of 8 lb. per square foot on the bare conductors (ice-free).

An unbalanced tension in one conductor equal to the final tension at 60°F. (7,900 lb. for the St. Lawrence lines) is also used but is not combined with either (*a*) or (*b*) above. Instead, it is combined with a wind pressure of only three lb. per square foot on the bare conductors. These two combinations of structural load are the basis for the design of the lighter type W1 and type X1 towers.

Although this change in design load represents a significant departure from Ontario Hydro's previous practice, it is based on studies of weather records and many years experience in line maintenance. The basis of the design of a transmission tower is different from that of other steel structures, such as the superstructure of a bridge for example, because the magnitude and frequency of the loading which will be applied to the tower during its lifetime depends almost entirely on the weather, and is likely to vary over quite wide limits. The severity of this real structural loading on transmission lines also varies widely according to geographical locations. Because of the lack of precise measurement of the effect of storm loading on transmission lines, and the variations in their probability of occurrence, there has been a natural tendency among transmission engineers toward conservative design. As years of experience have been obtained in transmission line construction and maintenance, together with increasing knowledge of the effect of these loadings on the towers, design loadings in the industry have been reduced. This latest reduction by Ontario Hydro represents another step in that direction.

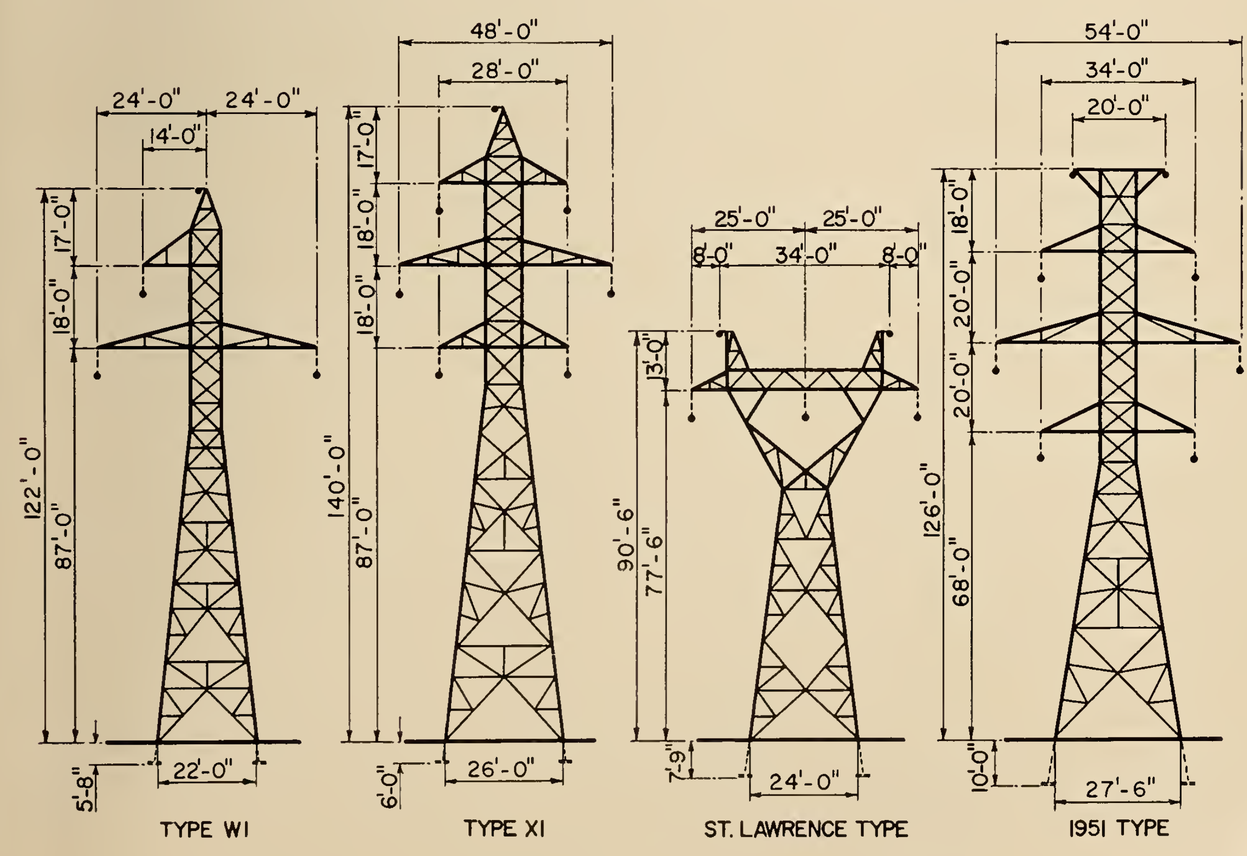
Along with the previous heavier loadings, the working stress in tension, for CSA grade G40.4 steel, had been taken as 24,000 psi. On a guaranteed yield point of 33,000 psi, this represented a factor of safety of 1.38. On the new lighter designs, this working stress has been increased to 28,000 psi, which reduces the factor of safety to 1.2. This step was taken as a result of much test data which demonstrated the reliability of our design

TABLE I

DATA REFER TO THE TOWERS SHOWN IN FIGURE 1.

TYPE OF SUSPENSION TOWER	W1	X1	ST. LAWRENCE	1951
WEIGHT OF TOWER (LBS)	11,920	16,674	12,200	25,170
WEIGHT OF FOUNDATION (LBS)	2,235	2,637	3,140	4,737
EXCAVATION (CU. YDS. / FOUNDATION)	31·2	33·7	44·0	48·9
AVERAGE SPAN (FT)	1,440	1,440	1,130	1,130
NUMBER OF TOWERS PER MILE (AVER)	3·7	3·7	4·7	4·7
TOTAL WEIGHT OF TOWERS AND FOUNDATIONS PER MILE (TONS)	26	35	36	70
EXCAVATION PER MILE (CU. YDS.)	114	124	206	229

Fig. 1. 230 kv. suspension towers associated with the St. Lawrence power project.



formulas and also as a result of the industry's production of consistently good quality steel.

Comparison of Towers and Foundations

Data concerning the four suspension tower designs are presented in Table I. All the towers were designed for the same conductor size and tension. The main differences are in structural design loading and span length application.

It should be noted first that the single circuit towers are not directly comparable in transverse strength. The St. Lawrence type, which was designed for a specific site, will take a maximum tangent span of 1,320 ft. Since the actual average span was 1,130 ft., this means the St. Lawrence type could not be used to support an angle in the line. The W1 suspension tower on the other hand was designed as a general purpose tower to support an angle in the line of 3 degrees on an 1,100 ft. span. This gives the W1 tower a theoretical maximum tangent span capability of something in excess of 1,750 ft.

The two double circuit tower designs, however, are directly comparable since they were each designed to support an angle in the line of 3 degrees on an 1,100 ft. span. A comparison of the type X1 and 1951 type suspension towers, therefore, gives a clear picture of the result of using the lighter structural design loadings.

To begin with, the total weight of steel used per mile has been cut in half. This applies, of course, to long transmission lines such as the St. Lawrence application of the X1 tower. On shorter lines, with a significant proportion of anchor towers, this reduction would not be as great.

The second point to note is that the average number of towers per mile has been reduced by one. This use of a higher tower and longer span in the X1 application does not contribute to the reduction in weight of steel. Preliminary designs showed that, had the type X1 used a tower height and span length similar to the 1951 type, the reduction in weight of steel used per mile would still have been of the same order. The real saving in the use of a longer span is the reduction in the number of sites to which access must be gained with excavation equipment and in the number of foundations which must be set.

It will be noted that the arms on the type X1 tower are slightly shorter than those on the 1951 type tower. This change reflects a trend which has continued since Ontario Hydro's first double circuit 230 kv. tower designs were introduced in 1940, and is based on experience with the patterns described by galloping conductors. The limiting factor which sets the length of the short arm on the type X1 tower is the requirement to support a 3 degree angle in the line. Under this condition, the string of insulators will swing toward the shaft through an angle of approximately 35 degrees.

The foundations on all of these suspension towers are of the steel grillage type. Those on the lighter towers are not set as deeply as on the heavier ones. Although a deeper foundation on the type X1 would have resulted in a further reduction in weight of steel, it would have produced a more costly foundation. Excavation and setting costs on foundations rise rapidly as the depth increases beyond six feet.

The installed cost of foundations contains a greater proportion of labour man-hours than does the installed cost of the towers. The increasing ratio of labour to material costs over the past 12 years has caused foundations to form a greater proportion of the cost of the whole transmission line. For this reason, it is in the tower foundations that the greater savings can be made by the use of more efficient designs, and much work is still in progress on this problem.

Conductor

The four types of towers were designed to support Grackle ACSR (1192.5 MCM, 54/19). Subsequently, during the survey for location of structures, the Aluminum Company of Canada, in collaboration with Ontario Hydro, produced a new conductor designed specifically to meet the requirements of the St. Lawrence lines. It has been given the appropriate name Seaway ACSR (1277.5 MCM, 42/7). It has the same diameter as Grackle and is designed for the same tension (loaded with ½-in. ice and 8 p.s.f. wind) of 15,000 lb.

The new conductor has a smaller steel core and a greater cross section of aluminum. Since it is loaded to the same tension as Grackle, its unit stresses are greater. At 0°F. without ice or wind, the new conductor reaches a load in tension of 25% of its ultimate strength.

The advantages of using this special design are a decrease in electrical resistance of 7% and a decrease in conductor cost of 6%.

Ground Cables

An interesting feature of the type X1 tower is its adaptability to the use of either one or two ground cables (sky wires), whichever is considered necessary. There is an interchangeable double ground cable peak, similar to the 1951 type, which may be used with the type X1. It may also support two ground cables by using a single peak, as shown in Fig. 1, for the first ground cable, and stringing the second through the centre of the shaft, supported at a point slightly below the middle crossarm. A single ground cable at the top of the tower provides sufficient shielding. The second ground cable adds to the capacitive coupling between ground cables and conductors and may be used in those areas where lightning activity is severe or on lines where the resulting increase in service security is worthwhile. The advantage in having the support position for the second ground cable located lower on the shaft is in the facility with which such cable can be added if experience should indicate that this is necessary.

Overall Cost Comparison

Theoretically, if the 116 miles of transmission line, on which the type X1 towers were used, had instead been designed and constructed using 1951 type towers, the total cost of the line (excluding right-of-way) would have been increased by approximately one third.

World Power Conference Sectional Meeting

The October issue of The Engineering Journal will contain a report of the technical highlights of the World Power Conference Sectional Meeting, which was held in Montreal 7 to 11 September.

Development of Great Lakes Harbours

Major-General H. A. Young, M.E.I.C.

Deputy Minister, Department of Public Works of Canada

MANY ARTICLES have been written about the St. Lawrence Seaway and the ships that will come up from the ocean, but still some normally intelligent people believe that the *Queen Mary* will tie up at Yonge Street dock in Toronto and the aircraft carrier *Bonaventure* will tie up alongside the navy wharf in Hamilton. At the risk of repeating facts that are already well known, some basic information considered by the Government of Canada in considering the questions of what harbours should be developed and the nature of that development is presented here.

The Seaway is not something new; Canada has had a Seaway for many years and deep sea vessels have been coming into the Great Lakes for over half a century. The new Seaway will open the door a little wider; as a matter of fact, there are still quite a few locks on the door and these locks have to be opened one at a time to allow ships to come into and to leave Lake Ontario.

The size of ships using the St. Lawrence Seaway is strictly limited by the size of the locks and depth of the channels. The number of ships coming up is limited by the number of ships a lock can pass through in any season. Ships that come up must also go down, and they go out of that same door as in they came. Therefore, the amount of freight entering and leaving the Great Lakes has a physical limitation. The most recent estimate of the probable maximum tonnage which the locks of the Seaway can pass, is in the neighbourhood of 35 million tons annually. The present tonnage carried by the existing St. Lawrence canals is approaching 10 million tons. The difference of 25 million tons is the likely increase until the Seaway facilities are doubled.

Many of the communities on the Great Lakes optimistically expect to receive a big percentage of this 25 million tons. Not only Canadian cities, like Toronto, Hamilton, Windsor, Sault Ste. Marie, Port Arthur and Fort William, and the many small Canadian ports, but United States' cities, such as Rochester, Cleveland, Chicago, and Duluth, will share part of this tonnage.

This paper reviews the effect of the St. Lawrence Seaway on the ports of the Great Lakes, and some of the work being done by the Department of Public Works of Canada.

At present the bulk of traffic entering and leaving lake ports is lake traffic and it is likely to remain so for many years. For example, in 1956 the tonnage of freight handled in Toronto Harbour reached almost 6 million tons but only 165,000 tons or 3% was foreign shipping other than United States. It is probable that from 80 to 85% of the traffic through the canals will be bulk cargoes such as iron ore, wheat and coal. However, the nature and volume of general traffic will depend to a large extent upon the toll structure which at the time of writing has not yet been finally agreed.

Until such time as definite predictions can be made about the freight potentials of lake harbours, and actual patterns of trade have been established, the Department of Public Works will concentrate its assistance on the establishment of deep water facilities in Toronto, Hamilton, Fort William and Port Arthur. The cities of Windsor, Sarnia, and Sault Ste. Marie are being given serious study and when conditions warrant the development of port facilities, the Department will be prepared to cooperate in carrying out the necessary work. This, of course, does not mean that other ports will not receive assistance in the maintenance and establishment of facilities to lesser depths.

The cities of Toronto and Hamilton will have facilities to receive vessels coming up the St. Lawrence at the opening of navigation in the Spring of 1959. Port Arthur and Fort William will not need the deep water until 1962 because the channels leading into Lake Superior will not be dredged to Seaway depth until then. This latter work is being carried out by the United States Corps of Engineers.

With the exception of some of the more understandably enthusiastic advocates of other municipalities, most people will accept the validity of giving top priority to these four harbours. As the need for providing facilities at other locations becomes evident, they will receive serious consideration by the Department of Public Works.

Harbours in Canada fall under three classes for purposes of administration. The National Harbours coming under the National Harbours Board include Halifax, Saint John, Quebec City, Chicoutimi, Three Rivers, Montreal, Churchill, and Vancouver. Eight other harbours such as Toronto, Hamilton, and Windsor, come under what is known as Local Harbour Commissions. The Government proposes to establish a Harbour Commission at Fort William and Port Arthur which will bring the total of Commissions to nine. All other harbours, amounting to several thousand, come under the direct administration of the Department of Transport.

In the case of the National Harbours, the Board is generally responsible for works of a public nature, although in a few special instances the Department of Public Works will carry out certain dredging.

In the Commission harbours, there is less uniformity of practice because of differing antecedents and stages of development, as well as varying local conditions. Each has its own Act of Parliament, however, and the tendency is to make them more self-sustaining. For the remainder, the Department of Public Works carries out all public dredging and the building and maintenance of all public structures.

The major activity of the Department of Public Works in Toronto is the improvement of the main channel in the harbour, and its approaches. In the neighbouring harbour of Hamilton, both dredging to accommodate Seaway traffic and the construction of certain terminal facilities are under way. At the other two of the four harbours to which special reference has been made, Fort William and Port Arthur, the Department is engaged in a programme of Seaway dredging that is scheduled to coincide with the completion of the deepening of channels in the St. Marys River, the entrance to Lake Superior.

Fig. 1. General plan of Toronto Harbour.

CHANNEL STANDARDS

It was agreed by the Governments of Canada and the United States that the Seaway would provide channels adequate for ships drawing 25½ feet. This was generally accepted as a channel with a minimum depth of 27 feet.

In deep sea ports, the mean sea level never changes and ships can be assured that the water level in the harbour will be at mean sea level four times a day and many harbours can only be entered at or approaching high tide. Ships can, therefore, enter these harbours for a good percentage of the time every day, year in and year out.

The levels of the lakes vary too, but for different reasons; basically the difference is a reflection of the variation in the hydrologic cycle, but the high levels of the lake may occur once in fifty or sixty years, so ships could not afford to wait until high water for entry into a harbour. Even mean lake level would sometimes not be equalled or exceeded for several years.

Therefore, it is important to select a zero datum from which to measure this agreed channel depth which will give access to main harbours for vessels with a 25½ foot draught for most of the time.

In the past, the level of Lake Ontario has fluctuated widely, with a recorded mean monthly minimum level of 242.6 feet above mean sea level and a maximum mean monthly level approaching 250.0 feet above mean sea level. This is a variation of about 7½ feet. As well as channels, docks and loading and unloading facilities must be prepared for this difference.

With the completion of the control structure at the outlet of Lake Ontario and the assumption of lake regulation by the International St. Lawrence River Board of Control, the levels of Lake Ontario will be kept between a mean monthly elevation of 244.0 and a maximum mean monthly level of 248.0 feet above sea level. This artificial control will be very helpful for the planning of harbour developments.

Lake Superior has been under regulation by the International Lake Superior Board of Control for many years and harbours in the upper lake are not subjected to lake level variations that are as great as the other lakes. This is due both to the control exercised at Sault Ste. Marie and to the larger area of Lake Superior.

The figures mentioned above for Lake Ontario are mean monthly levels and the water levels fluctuate daily, and the mean daily level may be as much as one foot different from the mean monthly; and the instantaneous levels may be as much as a foot different from the mean daily level.

It would be ridiculous to design harbour facilities for water levels that would only be reached once every fifty years; it would be uneconomic to design channels that would only be used to the maximum capacity 1% of the time. To add an additional foot to the depth of Toronto Harbour would mean the expenditure of up to 4 million dollars. Considered as insurance, the annual premium of $300,000 is quite a big sum to pay for the extra few tons of shipping which would only use the maximum harbour facilities for as little as 1% of the time. After due consideration, the level of Lake Ontario selected by the Department of Public Works as the zero datum for channel construction is 243.0 feet above mean sea level. For Lake Superior, this zero datum is 601.6 feet above mean sea level.

In determining the depth of the channel to be provided, it is necessary that certain clearance be considered. Sufficient clearance must be provided under the keel of the vessel to permit it to move safely and at an efficient speed. Increased clearance must be provided for rock bottom over that for soft bottom because of the serious damage which would result to a vessel it it strikes ledge rock or boulders and for a factor of safety against fragments of rock or boulders that might be turned up to extend above the project depth plane during the periods between maintenance operations in the channel.

Additional clearances must be provided in exposed areas, as compared to sheltered areas, as vessels are subject to vertical movement because of storm and wave action.

Fig. 2. Western entrance to Toronto Harbour. Channel dredging by dipper dredge *A. L. Quinlan*.

In the inter-connecting channels, the following general principle has been adopted for establishing the amount of this clearance;

"Total clearance allowances should be 0.5 feet in sheltered channels with soft bottom; 1.5 feet in exposed channels with soft bottom; 1.5 feet in sheltered channels with hard bottom; and 2.5 feet in exposed channels with hard bottom."

In addition to the clearances which must be provided between the draught of a vessel and depth of channel, an allowance must be made for the "squat" of a ship when under way. Squat is defined as the increase in draught assumed by a vessel when under way over that when it is at rest. The squat increases with increase in speed, the rate of increase becoming greater as the speed increases. The older vessels of the present Great Lakes cargo fleet operate at a speed of 10 to 12 miles per hour and the standard allowance of one foot for "squat" that has been made in the past is considered to be adequate for the present need. However, many of the newer vessels operate at speeds of 17 to 18 miles per hour and the trend of new construction is toward such higher speeds. Therefore, additional allowance for squat will be necessary in unrestricted channels to provide adequately for the fleet as it may be expected to be constituted during the life period of the improvement.

TORONTO HARBOUR

The design depths of Toronto Harbour vary; the western entrance to Toronto Harbour is exposed and the bottom is in rock, therefore, clearance allowance of 2.5 feet is to be made. As vessels approaching will be at a slow speed, no allowance for squat is required. Therefore, the channel depth required is 28 feet (25.5 and 2.5 feet) below the zero datum of 243.0 (U.S.L.S. 1935).

Inside Toronto Harbour no allowance for squat is required and as the channel is protected, a clearance of 1.5 feet is all that is necessary. A channel depth of 27 feet, measured from selected minimum water level, is all that is required in Toronto Harbour.

A study of the directions of the prevailing winds on Lake Ontario indicates that winds from the southwest in excess of a Beaufort No. 5 occurred on 217 occasions during the navigation season from 1943-52 inclusive. (A Beaufort scale of 5 is equal to a wind of 19 miles per hour.)

The channel between the breakwaters is in a general direction southwest—north-east and might be considered exposed waters when the wind is from the south-west, but considering the number of times this would occur during periods of low lake levels no additional allowance can be justified.

Based on the standards established by the Department, a contract for excavation of the western channel entrance has been let for the removal of 165,000 cubic yards of Class "A" material and 520,000 cubic yards of Class "B" material. The time limit of the contract is 18 months, to be completed by November 30, 1958.

The Department has also let a contract for dredging the first section of the channel inside the harbour, extending from the western channel entrance to Parliament Street Slip. The tenders for the second section of the Harbour channel dredging have also been received and this part of the project will be completed by April 1, 1959.

The channel dredging inside the Harbour, included in these two sections, is about 180,000 cubic yards of Class "A" material, which is rock, and about 800,000 cubic yards of softer material, Class "B". Fig. 1 shows the general dredging programme being carried out by the Department of Public Works, and Fig. 2 is a view of part of the equipment being employed in this location.

These items include all the immediate plans that the Department has for harbour improvements in the Toronto area. The Toronto Harbour Commission, however, has made some long-range plans for the development of the Harbour, but the timing of the various parts of these long-range plans will depend on the effect of the St. Lawrence Seaway following the establishment of toll structures.

Fig. 3. General plan of Hamilton Harbour.

HAMILTON HARBOUR

The Department is now carrying out dredging in the channel and some construction of structures in Hamilton. Contracts for structures now under way include the Strathearne Avenue Wharf, 1200 feet long, of pile bent concrete deck construction; the new Ship Street Terminal No. 3 Wharf, 1292 feet by 833 feet, also of pile bent concrete deck construction; and the Wellington Street Wharf Extension, 1106 feet by 619 feet, of steel sheet pile construction. It is expected that these structures will be completed in the Spring of 1959. A dredging contract for 700,000 cubic yards will be completed this year. The removal of an additional 500,000 cubic yards is now under way and a contract for another 200,000 cubic yards has been let scheduled for completion before the opening of navigation in 1959.

The dredging being done by the Department of Public Works is shown on Fig. 3.

Burlington Channel, which is a bottleneck at the entrance to Hamilton Harbour, is to be improved. The Ontario Government is building a new high-level bridge to carry through traffic over the canal (Fig. 4). As a Federal Government project, two existing old moveable bridges over the canal are being replaced by one lift span to carry both rail and highway traffic. The centre piers will be removed and the channel dredged to Seaway depth for the whole width of the canal. This project is scheduled for completion during 1960.

The Hamilton Harbour Commission has long-range plans for development, but, as with Toronto, the timing of the various parts of these long-range plans will depend on the effect of the Seaway.

FORT WILLIAM AND PORT ARTHUR

Getting ships into Lake Ontario is only one of the steps on the way to Lake Superior and the upper Lake ports of Fort William and Port Arthur. The St. Marys River channels will not be completed to Seaway depth until 1962, so that the pressure on facilities in the upper Lake ports will not be felt until that time. The dredging programme for the upper Lake ports is, therefore, scheduled over a longer period than that for the Lake Ontario Harbours. Contracts for the removal of about 700,000 cubic yards from these two harbours are scheduled for completion during 1958. Future dredging requirements will depend on the plans for development to be carried out by the Harbour Commission which will be ap-

Fig. 4. The Burlington 'skyway', a high-level bridge to carry traffic over the entrance canal to Hamilton Harbour. (Part of the Queen Elizabeth Highway)

pointed after the legislation setting up this authority has been given Parliamentary approval.

Under the new legislation, public wharf facilities will be provided by the Department of Public Works as a joint development of the two cities of Fort William and Port Arthur. The proposed new facilities will be located adjacent to the common boundary of the two communities and will be transferred to the Harbour Commission for administration.

When the exact location of the wharf has been determined, a survey of dredging requirements will be made and the necessary work carried out by the Department of Public Works.

OTHER GREAT LAKES PORTS

There are a large number of ports on the Great Lakes that are used by fishermen, fuel carriers, and package freighters, which are of considerable local importance and which receive assistance from the Department of Public Works in the maintenance of dredged channels, and in the construction and maintenance of wharves.

One of the most serious problems is the maintenance of adequate channel depths by dredging or remedial works. Littoral drift along the lakeshore in some places fills in channels almost as quickly as they are dug out.

The Department, in co-operation with the National Research Council and Queen's University, have undertaken a comprehensive study of this problem. It is hoped that this investigation will result in the saving of many hundreds of thousands of dollars annually to the Canadian taxpayers and produce more satisfactory harbour conditions for the many ports in the Great Lakes area.

CONCLUSION

The Department of Public Works is spending many millions of dollars annually in the improvement and maintenance of harbour facilities and channels in the Great Lakes area. With the expanding requirements likely to result after the opening of the deeper waterway, it is expected that the annual contribution to these services will be even greater.

MODIFICATIONS TO THE JACQUES CARTIER BRIDGE

The picture below shows the start of the Seaway channel opposite the harbour of Montreal. The Jacques Cartier road bridge is in the foreground, with the Victoria road and rail bridge behind. Some of the work involved in altering these bridges where they cross the Seaway channel is described in the article on page 55 to 68 in this issue. There will be a further paper 'Modification of the Jacques Cartier Bridge for the St. Lawrence Seaway' by R. E. Chamberlain, M.E.I.C. in the December *Journal*. *(Photo: Dominion Bridge)*

INTERNATIONAL NEWS

Industrial Notes from Italy

ITALIAN BUSINESS and industry have developed remarkably in recent years, and many industries are enjoying a flourishing export trade. Some typical examples are mentioned briefly here, though the field covered is far from comprehensive.

Balance of Payments

Italian gold and foreign currency reserves increased by $343.7 million between 1 July, 1957 and 31 March, 1958, compared with $31.4 million in the corresponding period of 1956-57. For January-February 1958 the overall balance of current payment showed a surplus of $24.3 million as against a deficit of $3.3 million the previous year. Foreign investments rose from $8 million in the first quarter of 1957 to $26.6 million in 1958.

The largest deposits of white marble in the world are in the Apuan Alps, an offshoot of the Appenines. Used since before the Christian era, some 500,000 metric tons are taken each year from 550 quarries. Exports of block and sawn marble in the first half of 1957 totalled 3,383 million lire.

Six prestressed concrete conduits, 11,707 ft. long, are being installed in the plain of Taranto, southern Italy. Each element is 52½ ft. long, 63 in. i.d., and 7-3/32 in. thick, with a 15¾ in. section ring at the ends, and weighs 47.4 tons. Hydraulic head is 57 ft. There is no circumferential prestressing, but longitudinal prestressing by rectangular-section steel bars is used to counter tensile stresses in the lower section amounting to about 470 p.s.i. Concrete is poured in horizontal steel moulds, with vibration, followed by steam curing for 36 hours. The Ferrocemento Company, of Rome, is doing the work as part of the Mezzogiorno development.

Development of roads in southern Italy includes the Salerno-Pompeii highway along the steep coastline. Seven of eight bridges were built by E. Grassetto, of Padua, with two tracks at different levels to reduce the amount of rock excavation involved.

Development of Southern Italy

The outstanding undertaking within the country is the program for the development of the southern part of Italy (the Mezzogiorno). A new law facilitates the efforts of government and private enterprise to alleviate social and economic conditions in the region by encouraging new agricultural and industrial initiative and providing an interdependent program involving road construction, land reclamation, pilot industrial zones, schools for professional instruction, and training of specialized workers.

In just over seven years, to mid-1958, $1,393.6 million have been invested in the Mezzogiorno, divided as follows (in $ millions): reforestation, land reclamation, irrigation, 366.4; soil improvement, 262.4; additional land reform agency works, 372.64; roads, 148.0; railroads, 76.8; aqueducts and sewage, 124.8; and tourist development, 23.0. In addition, three Southern Institutes have, in four years, contributed $400 million for fixed installations and $80 million for operational credit.

Some 6850 miles of country roads have been repaired, and 870 miles of new main roads built plus 2500 miles of roads in reclaimed areas. Savings on transport costs from this development are estimated at several million dollars a year.

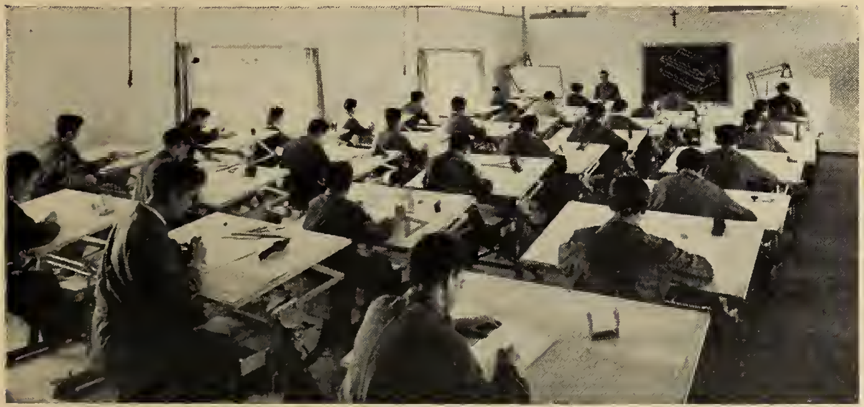
Aircraft Industry

The aircraft industry, long known for its engineering quality, has been boosted by the acceptance of the Fiat G.91 as the NATO standard light tactical fighter. The plane, equipped with a Bristol Orpheus B.OR 3 turbo-jet engine made by Fiat under license, will be mass-produced in Italy, France, and Germany.

Another jet aircraft, built for the Italian Air Ministry, in agreement with NATO, is the Ariete, from the Aerfer plant of Pomigliano d'Arco. This interceptor aircraft first flew on 27 March 1958. It has a maximum speed of Mach 1.1, with a rate of climb of 4 min. 20 sec. to 12,000 metres (about 39,400 feet). Take-off and landing runs are only 1640 feet and 2950 feet, respectively. The main engine is a Rolls-Royce Derwent, which discharges under the fuselage, and there is a rear auxiliary for additional thrust during take-off, attack, and so on. This engine has its air intake on the top side of the fuselage and exhausts from the tail of the aircraft.

The Aerfer Ariete light interceptor fighter.

Fiat G.91 jet light ground attack fighter.



Above, drawing room of the Olivetti training school, Ivrea. Below, electrical measuring instruments and experimental laboratory in the Fiat central training school, Turin.

Industrial Training Schools

The importance of technical and professional training is widely recognized by Italian industry. Two examples of the training schools organized by private industry are those of the Olivetti Company, manufacturers of office equipment, and the Fiat organization, which is noted for automobiles and aircraft.

The Olivetti School

The Olivetti family, father and son, have been prominent in the field of Italian industrial architecture and the industrial design of equipment. Their efforts towards the highest standards of quality and efficiency have been helped by the availability of suitably trained personnel. The company's training school for mechanics, at Ivrea, was organized a few years before World War II. Courses last five years and are divided into two terms. For the first three years the trainees spend about two-thirds of their working day in the school workshop, as unskilled workers, alternating practical work with theoretical lessons. At the end of the five-year course, the successful pupil receives a government-recognized diploma, and can then specialize according to his aptitude and the plant requirement for such trades as mechanic for assembly and repair, electrician, toolmaker, draughtsman, and so on.

The trainees, who may be admitted between the ages of 14 and 16 by examination, have the same working conditions and benefits as qualified employees, and salaries are only 17 per cent below the regular rates.

Machinery, machine tools, and precision instruments are produced, and largely designed, by the school, which includes a planning department responsible for the production schedule and cost control.

The tools and machinery produced in the school are distributed to the company's plants throughout the world.

Selected students can proceed to university or Polytechnic Institute, and there is also a 'specialization course' of five years, from which a diploma, also recognized by the government, is obtained. Graduates from this course qualify for administrative jobs in such fields as control and planning.

The Fiat School

Fiat has established the 'Giovanni Agnelli' central apprentice training school in Turin, where the company, founded in 1899, now employs 80,000 people. Boys of 14 to 16 years old with a secondary professional school certificate are admitted by examination and are given a three-year course in practical and theoretical subjects. English is taught, particularly as far as technical terminology is concerned, as well as Italian, mathematics, physics, chemistry, drawing, and electrical and mechanical technology, together with physical education.

Under the direction of Prof. Aldo Peroni, 80 teachers instruct some 900 apprentices in theory. A similar number of technicians give practical instruction. In addition, some thousands of workers are given special one-year vocational guidance courses to maintain the supply of semi-skilled employees.

The new school is exceptionally well equipped with locker rooms, washrooms, and a large medical department. Equipment includes some 400 machine tools, many of which have been built by the apprentices themselves. In addition to the large machine-tool shop there are shops for electrical work, electronic testing, and machine tool production.

Newly-graduated engineers are also given a two-year course, including six months in the school workshops to gain experience on the various machine tools.

Fiat was the first major industrial concern in Italy to establish its own apprentice training school, in 1922. Many of the early trainees now hold managerial positions in the company.

The information and illustrations for these notes were supplied by the office of the Commercial Attache to the Italian Embassy, in Ottawa, and from material published by the Confederazione Generale dell' Industria Italiana, Rome.

UNITED KINGDOM

Typewriters for Scientists

A development that should also be of interest to editors who receive scientific manuscripts is a two-keyboard typewriter for reproducing scientific and mathematical formulae.

Designed by the Imperial Typewriter Company, in England, for the Atomic Energy Research Establishment at Harwell, machines can be produced to meet the individual requirements of other organizations or scientists.

The two keyboards are mounted side by side, with a common moving carriage unit. One keyboard is more or less standard, the other carries the required symbols such as the Greek alphabet, root and integral signs, and so on. Symbols from this keyboard fall accurately into position in the main text. Altogether 180 characters are available on the machine.

Similar machines have been exported to Australia (in connection with research at the Woomera rocket range), Belgium, Switzerland, and South Africa, while orders are due from Denmark and the United States.

Apart from this special application, typewriters are also available in such languages and script as Siamese, Hebrew, Russian, Arabic, Eskimo (engineers in northern Canada, please note), and Braille.

Training for Nuclear Power Work

The Harwell Reactor School was founded in 1954 to train men from industry who were to design and build nuclear power stations. Originally for British subjects only, courses are now open to foreign students.

The school caters primarily for graduate engineers and physicists in the respective fields of reactor engineering and reactor physics, with lectures on basic physics for the engineers and on engineering subjects for the physicists.

Some of the subjects covered include design of biological shields, reactor control and instrumentation, moderator and fuel manufacture and chemical processing, metallurgy, reactor safety, and radioactive effluent disposal.

The standard course lasts 16 weeks, the first part being held at one of three Colleges of Advanced Technology (at Birmingham, Bradford, and Salford, near Manchester). The more specialized part of the course is held at Harwell, where experimental work is carried out.

By mid-1958 a total of 718 students attended standard courses at the school, including 144 from abroad. A standard course, for 60 students, will run from 10 November 1958 to 6 March 1959. Any student of degree standard may attend, but foreign students must be sponsored by their government or by a recognized atomic energy agency in their country. Fee for the course is £250 (without accommodation).

There is also a two-week senior technical executives course (fee £50) for senior industrialists who have a technical background, and special courses have been held for such groups as scientific correspondents of the press, professors from European universities (at the request of OEEC), and technical college teachers (run for the Ministry of Education).

SWITZERLAND

Geneva Conference on Atomic Energy

The second United Nations International Conference on the Peaceful Uses of Atomic Energy was held in Geneva 1 to 13 September. At the first conference, in August 1955, some 1070 papers were submitted, 300 advisers and observers attended, and proceedings were reported by about 1000 representatives of press, radio, and television.

This issue goes to press during the present conference, but it is known that the program dealt with the five series of physics, reactors, chemistry, isotopes and radiological protection, and raw materials and metallurgy in a total of 77 sessions, compared with 55 sessions in 1955.

The special exhibit, in which 21 governments were represented, increased from 1600 square metres (9 countries represented) in 1955 to some 7000 sq. m. this year. Canada was strongly represented both at the technical sessions and in the exhibition of material.

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

South Saskatchewan River Dam

Another important step forward in the development of Canada's resources has been taken, with the signing of the federal-provincial agreement on the South Saskatchewan River Dam. Years of discussion and study were climaxed in July by signing of a cost sharing agreement outlining in detail the responsibilities of the two governments in construction and maintenance of the earth dam and other structures.

Work was to start immediately, supervised by the PFRA director at Regina, Gordon McKenzie, assisted by George Munro, chief engineer.

This is a gigantic project, surpassed only by the St. Lawrence Seaway in size and economic importance, according to one commentator.

It can provide irrigation for 500,000 acres of soil in an area of 300 miles, directly benefiting 50,000 farms. The ultimate benefit will require more than 25 years to be achieved. An area of 50,000 irrigated acres will be the first target, soon after the dam is completed, a six to eight year program.

The project will require the construction ot an earth dam, between the towns of Elbow and Outlook on the Saskatchewan River, at what is called the Coteau Creek site. Associated with the dam will be a powerhouse having an installed capacity yet to be determined by the place this project will have in an integrated steam-hydro system which the province is planning. An auxiliary earth dam in the Qu'Appelle Valley will prevent escape of waters impounded by the main dam. The irrigation development would require the installation of 500 miles of main canals and laterals as well as 12 pumping stations.

The Federal Government will pay 75 per cent of the cost of the dam works, and the province the remaining 25 per cent. Saskatchewan will pay for the power works and for the irrigation system.

A dam at this site is not a new or recent proposal. Captain John Palliser and Prof. Henry Youle Hind investigated the same area in 1857 and 1858. The purpose in those days was navigation, but they then recognized the effect of a dam at the location now chosen.

Project Statistics

RESERVOIR: Length, 135 miles; area, 116,000 acres; total storage, 8.4 million acre feet; usable storage, 3.1 acre feet; length of shoreline, 475 miles; water depth at dam, 180 feet.

MAIN DAM: Height, 205 ft.; length, 16,700 ft.; volume of embankment, 40 million cu. yd.; volume of excavation, 52 million cu. yd.

SPILLWAY CHUTE: Length, 17,000 ft.; crest width, 520 ft.; capacity 265,000 sec. ft.

OUTLET WORKS: Length, 2,750 ft.; No. of barrels, 4; Size of barrels, 25 ft. dia.

QU'APPELLE VALLEY DAM: Height, 135 ft.; Length, 6,700 ft.; volume of embankment, 5.3 million cu. yd.

DRAINAGE BASIN: Total for river, 65,500 sq. miles; above damsite, 48,500 sq. mi.

IRRIGABLE AREA: 500,000 acres.

POWER: Installed horsepower, to be decided; Av. annual output, 475 million k.w.h.; power for irrigation pumping, 100 million k.w.h.

George Spence*, in *Regina Leader Post*

"This development will not only be of great benefit to the community and to the province but will ultimately strengthen the whole economy of the nation. Specifically the development is designed, among much else, to: (1) stabilize the agriculture of the region on a livestock basis; (2) provide hydro-electric power for domestic and industrial use; (3) provide a more abundant supply of good water for municipal and industrial purposes; (4) create greater facilities for recreation and other amenities of pleasurable living."

D. Cass-Beggs**, quoted in the *Regina Leader Post*

"The upstream storage would improve the power potential, and therefore, increase the value of the power sites that could be developed at points lower down the river."

* Former director of the Prairie Farm Rehabilitation Administration and an ex-member of the International Joint Commission.

**General manager of the Saskatchewan Power Commission.

A Report on Growth in the Engineering Faculties in Canada

Ninth article of a series

McGill University Makes Ready for Future Developments in Engineering

Engineering education has received more attention and attracted more discussion than at any other time, during the past year, McGill University's dean of the Faculty of Engineering, D. L. Mordell, M.E.I.C., wrote in his annual report of the 1957-58 term. He discussed the place of engineering education in a great university, and also reported on attempts to delineate the future development of the faculty. The conclusion is that at a time when man's knowledge of materials and machines is as vital for survival as man's knowledge of man, no university could be considered complete without an engineering faculty.

"We recognize the need for two types of engineers", said Dean Mordell. They are defined as the creative and operational engineers. In a general overall sense he does not regard one to be necessarily more gifted than the other. He recognizes in each a different kind of talent. Essentially the creative engineer is conscious of abstract ideas; he is likely to compose new technologies, in the abstract. The operational engineer may be no less creative, but his ideas will be in the application or device synthesis level. In both cases the capacity of independent thought, analysis, and synthesis is required. The university must provide the surroundings in which any latent creative ability can be developed. Those better suited to working with abstract ideas will usually show to better advantage in mathematics and other fundamental sciences, and for them more rigorous courses should be provided. Those men suited to application must take courses which will prepare them for the applications to be met in twenty years' time.

During the year the Faculty has recommended a study of the complete curriculum, and has modified its rules of promotion and standing. The aim is to establish as soon as possible whether a student is capable of following the courses. This helps also to correct the situation whereby the final year courses had become more analytical and exact, although no major changes in the curriculum as a whole, and particularly in the lower years, had been made.

It is hoped a new curriculum can be introduced in 1959, which will meet these criticisms. In combination with changed rules of standing and promotion, the new curriculum should raise standards and meet the objectives mentioned, Dean Mordell reported.

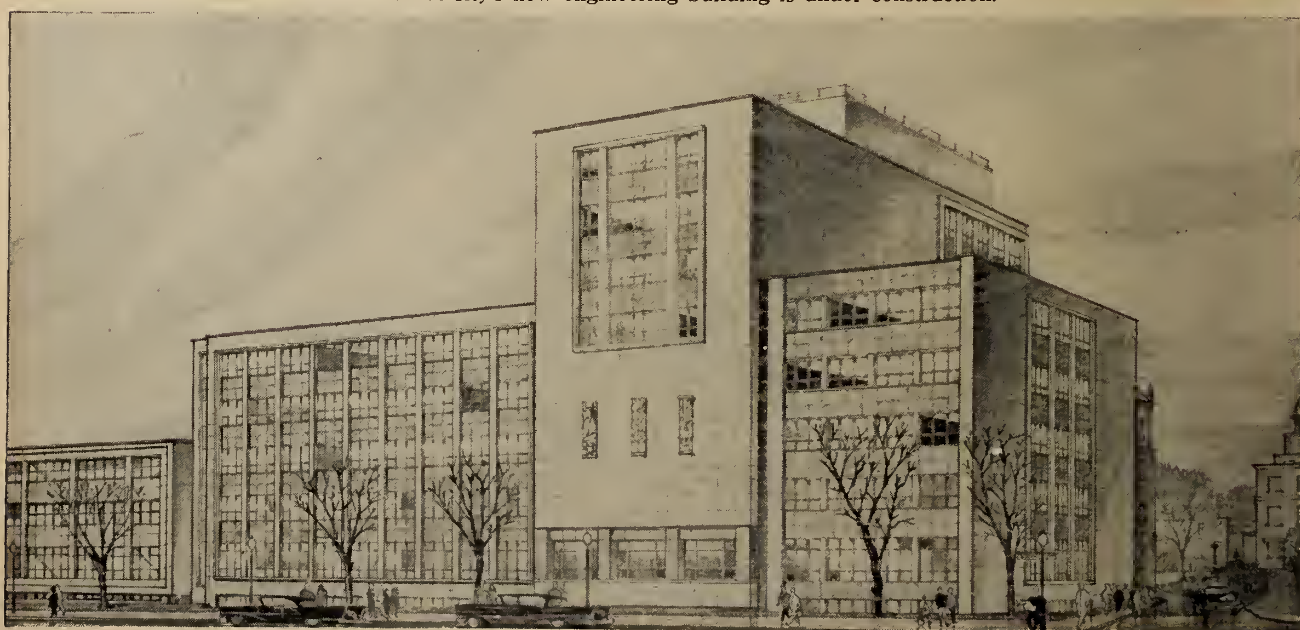
The year is noteworthy for the graduation of the first two students to complete the Mechanical Sciences Option in the Department of Mechanical Engineering, a new course requiring considerable mathematical capacity and calling for a large amount of independent work including a design dissertation.

In the past decade graduate study and research has steadily developed in the Faculty, though its growth had been hindered by numerous factors.

Staff changes are headlined by the retirement of Prof. George A. Wallace from the chairmanship of the electrical engineering department, and the succession of Dr. G. L. d'Ombrain. Assistant professors G. W. Farnell, T. J. F. Pavlasek, and J. W. Stachiewicz have been promoted to associate professors. Assistant professors T. H. Barton, K. A. Shelstad, and W. Mathison have been appointed.

Donors have made possible the creation of two new chairs, (in mining engineering and control engineering) and the Board has agreed to create a new professorship in the mechanical department.

McGill University's new engineering building is under construction.



Engineering building, McMaster University, is being built.

Facilities

In 1957 about 3,000 feet of additional laboratory space for the Department of Civil Engineering and two new classrooms were built. With this extra space it was possible to accommodate the increased enrolment.

The new building is under construction at the corner of Milton and University Streets, and the plan is for occupancy for the session of 1959-60. This will provide completely new quarters for the Department of Electrical Engineering and for the School of Architecture, as well as releasing space for expansion of other departments. It will make possible the implementation of programmes presently deferred for lack of space.

Outlook for the Future

In looking at the future, the considerable stature of McGill is associated with several favourable factors reported by Dean Mordell: the new building, the considerable salary increase in spite of financial difficulties, the hope of a solution to constitutional problems which prevent McGill from enjoying the support of the Canadian people. There are also the advantages of a larger enrolment and of the general awareness that the education of engineers and scientists is of national importance.

The plans envisage development of an active graduate school of larger proportionate size. There would be by 1965 an increase of student population to about 2500, distributed as follows: in ordinary courses, 1750; in honours courses, 500; in graduate course, 250.

First Year of Engineering Completed at McMaster

At McMaster University, Hamilton, Ont., the engineering students have completed their first academic year; the engineering building is under construction; the first staff members in the new engineering department have been appointed.

In September 1957, the first class of 48 students registered in the new course of Engineering Studies. These students will proceed in four-year courses leading to the degree of bachelor of engineering (B.Eng.) in chemical, electrical, mechanical and metallurgical engineering, and engineering physics. Registration in first year civil engineering will be accepted in 1959. The academic record of this first engineering year has been encouraging.

After a common first year, the course divides into two main branches—physical, and chemical engineering. The physical engineers pursue substantially the same curriculum through the third year, and specialization in all the engineering fields is developed in fourth year. The curriculum is being developed as a result of consideration of the following factors:

(I) The necessity of emphasis on fundamental science and mathematics;

(II) Opportunity for study in depth of humanities and social studies;

(III) The requirement that modern engineers be professional men capable of solving unfamiliar problems with imagination and judgment;

(IV) The considerable research activity in the physical sciences already well established on the McMaster campus.

As a result of these considerations, the curriculum has been planned with its primary objective the education of design and research engineers, and this same objective has governed the design of the new engineering building now under construction. The first year course in Engineering Studies is almost identical with Science Studies, except for the omission of English and the addition of graphic description and a mathematics laboratory. Either French, German, or Scientific Russian must be studied. In Second Year, English is a required subject, and one choice must be made from a list of six humanities and social studies. Laboratory time is available to all engineers for elementary design problems. This emphasis on original design is continued in third year, accompanied by intensification of Engineering Studies. In fourth year, each student is required to carry out an original engineering design or research project. A six-unit choice must be made in this year, too, from a list of electives in humanities and social

Progress on McMaster's Engineering Building, August, 1958.

studies. The time available for study in these latter disciplines amounts to about 19 per cent of total class time. Details of courses in the senior years will be worked out by the staff being assembled now.

The Engineering Building

Architectural design of the new building is by William R. Souter and Associates. The engineering consultant is O. M. Moffat, and C. C. Parker and Associates did the structural design. All branches of engineering will be accommodated in the three-story building, which has a total floor area of about 200,000 square feet and is located immediately south of the Physical Sciences Building, facing University Avenue. The "non-laboratory" services, such as offices, drawing rooms, lecture rooms, machine shops are in the central core, while the laboratories comprise the attached wings. This method has resulted in considerable economy in structure and laboratory services, as well as the isolation of fumes and noise. Consolidation of all of the engineering departments into a single building was considered desirable.

The main entrance to the building is by a covered terrace formed by the large lecture theatres which are supported on four circular columns. The lobby is paved with terrazzo. The central core of the building contains four draughting rooms (44 students each), six design-lecture rooms (35 students each), two standard lecture rooms (70 students each), two lecture theatres (200 and 300 students, respectively), machine shops, the professors' offices, and staff and student lounges.

The floor area of each of the chemical, electrical, mechanical and metallurgical engineering laboratory wings is 16,500 square feet. Since graduate and undergraduate work are stimulated by proximity, about 25 per cent of the total laboratory space is specifically allocated to research activities. All of the services are carried exposed on the columns or in the corridors; all fume-ducts are vertical to minimize corrosion; coloured concrete flooring is used in all laboratories, and the walls are painted concrete block.

In the chemical engineering laboratories, floor slots will accommodate equipment in the building up to 36 feet high, and a roof hatch will allow for very tall towers.

Provision has been made in the metallurgical engineering laboratories for a helium liquefier, nuclear magnetic resonance equipment, and a splendid photomicrography section. In addition to the machinery and electronics laboratories, a roof laboratory has been designed in electrical engineering for research on antenna design.

In mechanical engineering, there are to be laboratories for fluid mechanics, thermal power, heat transfer, and vibration studies.

The materials laboratories at the rear of the central core have 16 foot ceilings, a two-ton crane, and truck entries. All of the heavy testing equipment and concrete and asphalt fabrication will be located in these laboratories.

With the exception of the lecture theatres, which are faced with cut stone, the stonework on the building will be split-face Ashlar stone. Windows are continuous, and the wall sections between the horizontal window rows are panelled with coloured enamelled steel spandrels, edged with stainless steel.

W. H. Cooper Construction Company, Hamilton, is carrying out the construction on the basis of occupancy of the completed building on April 7, 1959.

Engineering Staff

By September 1959, the lecture and laboratory courses will be presented for the first time in third year, and the research laboratories will be available for graduate studies. The staff is prepared to cope with the stimulating and formidable task of purchasing and installing the necessary equipment. In addition to the original staff (Dr. Hodgins, Dr. Kirkaldy, Dr. Petch, Mr. Newcombe), four new appointments have been made: Dr. D. G. Huber as associate professor of mechanical engineering, Dr. A. S. Gladwin as associate professor of electrical engineering, Dr. T. W. Hoffman as assistant professor of chemical engineering, and Dr. G. Oravas as assistant professor of civil engineering. The complete academic staff will number about 30, for a total undergraduate student population of about 550.

Equipment

Laboratory equipment is to be purchased mainly from funds in the capital budget for the faculty of engineering. One major item, an electronic digital computer has already been bought, since there are research projects under way which now require this facility. The computer has many applications for the numerical solution of research problems in almost every phase of engineering. Other laboratory equipment is being acquired through the generous co-operation of philanthropic foundations, industry, and federal and provincial government grants. The one-megawatt nuclear reactor will be available for research work in the autumn of 1958.

First Year of Co-operative Engineering Studies Completed at Waterloo, Ont.

Early in April of this year, 71 students enrolled in Canada's first co-operative higher education course, completed Year One of their engineering studies at Waterloo College Associate Faculties. The following month an important Industrial Conference was held on the Waterloo campus, under the auspices of the Associate Faculties.

Attending the conference were more than 200 delegates, representing Canadian industry and the realm of industrial research. They met with top educators to learn about and discuss the philosophy and application of co-operative education in the field of engineering.

Co-operative education was introduced in Canada by the Associate Faculties at Waterloo in July, 1957. Under the Waterloo plan, student engineers spend alternate three-month terms on the campus and in industry. Teaching facilities are in operation 12 months of the year. One of the prime objectives of the co-op plan, the College officers explain, is to bridge the gap between academic theory and practical application so that students, upon graduation, possess a sound working knowledge of industrial processes, conditions and environments.

Said Dr. J. G. Hagey, president of Waterloo College and Associate Faculties: "The main difference between co-operative education and the traditional form is that the industrial assignments are a required part of the student's college course and that these assignments are controlled, guided and supervised by the College, in partnership with the companies committing themselves to the plan."

More than 100 Canadian companies

Industrial Conference at Waterloo College, May, 1958. The gentleman standing to ask a question is W. H. Evans, president of Honeywell Controls. Also prominent in the picture are Sir Robert Watson-Watt, and H. Barnett of Waterloo College.

participate in Waterloo's co-op education plan, the delegates were told. Ideally, two students are assigned to each job, so that while one student is pursuing academic studies his counterpart is working on a job, or "in-plant" assignment. At the end of each three-month term the positions are reversed. This arrangement gives participating companies the equivalent of one full-time employee.

The alternate academic and "in-plant" terms continue for six years (five years for Grade XIII matriculants) and lead to a B.Sc. degree in electrical, mechanical, civil or chemical engineering, or engineering physics. By the time the first class (July '57) graduates, in 1962, the Associate Faculties at Waterloo expects to have almost 3,000 students enrolled in engineering courses. This estimate is based on plans to admit a new class of 100 students every three months, or 400 per year. Already, the conference was informed, applications are exceeding enrolment limitations.

During open discussion Dr. Hagey was asked why Waterloo chose to establish co-operative engineering courses, rather than the traditional, or conventional, form of engineering.

"We were convinced," he replied, "that Waterloo, being in the stage of developing a new university, is in a preferred position to establish a co-operative course. Canada, not having previously had a co-operative college, did not develop a demand, even if there was a need for this type of education. Consequently, our established universities have not been under pressure to provide it. Waterloo, not having had an engineering course, found it just as easy to establish a co-operative course as it would have been to have established a traditional engineering course".

Dr. Hagey explained that while a degree-granting university charter is not actually required by the Associate Faculties until 1961, a "University Bill" for that purpose is being prepared, which would cause the Associate Faculties to emerge as the University of Waterloo.

Great importance has been attached to maintaining the high academic standards that exist in other professional engineering courses throughout Canada. The curriculum has been specially designed for this purpose. The teaching staff has been strengthened by highly qualified personnel and is attracting men of wide experience to this new venture in higher education.

The president emphasized that co-operative education is designed to supplement, not replace, the traditional forms of higher education. It makes university education available to qualified students who otherwise might not attend. It produces graduates who possess industrial experience along with their academic achievements. And it permits students to meet most, if not all, of their college expenses from their earnings in industry. In the case of Waterloo, it also takes higher education to a local area. "Our course is designed to produce better-than-average engineers, in quantity," Dr. Hagey stated.

Addressing the conference, Samuel Bronfman, President of Distillers Corporation Seagram Ltd., said, "To preserve our proper status in the world it is minimal that we keep pace with the advance of contemporary scientific and technical development. The path between the campus and the plant should be open and unhindered."

Sir Robert Watson-Watt, M.E.I.C., another conference speaker, called for the "utmost freedom of thought and action in scientific education." "Give universities and colleges much more money than you think they need and then, for Heaven's sake, leave them alone," was his recommendation to Canadian business and industry.

Estimated capital expenditures for buildings and equipment to develop the University of Waterloo during the next eight years is approximately $15 million.

As a voice of industry in co-operative education, Waterloo has an Industrial Advisory Council. Its function is to serve the specific needs of co-op engineering. It interprets industry's changing trends to the Faculty of Engineering and it helps keep the curriculum abreast of industrial developments and requirements.

St. Lawrence Seaway and Power Project

Progress by Ontario Hydro

With concrete placing in the Canadian half of the international power-house practically completed, and the power-house building ready for occupation, three generators were producing power at end of July. Some 2,100 persons were working on the Ontario Hydro half of the project at month-end.

Progress by NYSPA

With employment maintained at an average of 2,730 during July, placing of concrete in all structures had reached 97 per cent of the estimated total by month-end, while excavation had reached 91 per cent of the estimated total. Four units were generating power from the American half of the power-house at the end of July, with headpond level held at 4 ft. below maximum level.

At Long Sault dam the final stage of concrete placement was underway by early in July. Installation of the aluminum panels on the spillway gates continued, with work completed on five gates by month-end.

Channel improvements, exclusive of the tailrace were 98 per cent complete by month-end. A contract was awarded for channel improvement in the tailrace below the power-house and work had been started on construction buildings and cofferdams:

Thirty-seven miles of the Barnhart-Plattsburg transmission line were completed and the Plattsburg and Kent Falls substations were completed, with good progress being made on other transmission lines.

Progress by SLSDC

With the American navigation channel and Snell and Eisenhower locks in service since July 5, little remained to complete, and labour force was reduced by month-end to some 500 persons. Dredging of the south Cornwall Island channel was continued for fully 27 ft. depth.

On the new high level highway bridge opposite Cornwall, with decks completed on both approaches, cable stringing on the main span was completed, vertical cables hung and a start had been made on installing the steel for the main-span roadway.

Progress by SLSA

Excavation and clean-up operations on the overland channels are now in their final stages. On the St. Lambert lock, installation of gate machinery is complete except for electrical equipment and testing of pumps, etc. The last cofferdams holding water back from the river channel were removed in mid-July. At the Cote St. Catherine lock, gates are in place, with testing of gate machinery and clean-up proceeding.

On the Lower Beauharnois lock, with concrete all placed, only a small amount of dredging on the approach channel remains to complete. Installation continues on sector gates and on mitre gates and machinery. At the Upper Beauharnois Lock, with all concrete placed except for small sections of the upper approach walls, and with installation of gates and machinery under way, a suction dredge cleared the entrance channel upstream in mid-July. Test runs will be made in November on the four uncompleted Canadian locks.

Bids were called July 10 for a 3,600-ft. channel on north side of Cornwall Island to assure proper distribution of river flow around the island.

Other Seaway News

Lakehead cities moved a step closer in mid-July to getting their modern $4 million seaway-type harbour terminal, with second reading in the House of Commons to Bill C-26 incorporating the Lakehead Harbour Commissioners.

The long-awaited report on the impact of the Seaway on the Port of Montreal, prepared by the Montreal Research Council of McGill University during the past three years, was published July 27. Its findings: Montreal should gain substantially in grain, coal and iron ore traffic, with 50 per cent more grain handled by 1965 than in 1956; there would be little or no change in local petroleum traffic, probably a 35 per cent loss in general cargo handled; there was no particular stimulus for industrial location in the Montreal area, and thus little prospect of a major industrial boom.

Canadian Pipeline Projects

Westcoast Transmission:

The company's annual report March 31, 1958, reported a net income loss of some $2.8 million during the first six months start-up period. No trouble had been encountered with the pipeline even during the first spring thaw and rainy period in 1958, and compressor stations were working smoothly. By April 1958 both Inland Gas and B.C. Electric were on schedule in the attachment of customers, and B.C. Electric was proceeding with a $50 million installation program. By early fall, with completion of the 1958 gathering lines, construction over 80 per cent of the company's contracted gas reserves will be connected to the pipeline with an initial capacity to deliver 400 million cubic feet daily.

Alberta Gas Trunk Line Co.

Alberta Trunk's 1958 construction program of main line extensions and new laterals was almost completed at the end of July. The 144½ miles of 24 inch line from the Pincher Creek field to junction with Trans Canada at Princess was ditched out on July 27 and doping out completed by August 1.

Trans Canada Pipelines:

With over 1,300 miles of completed pipeline behind them, 12 construction spreads are at work between Port Arthur and Toronto with some 4,500 men. Their task is to lay 853 miles of 30 inch pipe from Lakehead to Maple, near Toronto, to bring Alberta gas to eastern cities. Total cost of 1958 construction will be about $165 million.

Five of the 12 contractors are working on the 367 miles of line from Port Arthur to Kapuskasing, being built by Northern Ontario Pipeline Crown Corporation, under supervision of Trans Canada. The other seven contractors are working on Trans Canada's 486-mile section from Kapuskasing to Toronto. There will be nine river crossings under separate contracts. Besides actual pipeline construction, six compressor stations will be built this year, five of them by Trans Canada and one by the Crown Corporation, with a total capacity of 48,500 hp. installed.

Canadian Western Natural Gas has begun construction on the new addition to gathering and transmission facilities, with some 140 men employed, to meet coming winter peak requirements. A 59-mile 16-inch lateral costing $2.8 million will be built from near Drumheller to supply the S.E. outskirts of Calgary. Overall expenditure on this lateral, the field gathering system, the Bow River Crossing and certain gas reserves will be $9.4 million.

Saskatchewan Power Corporation:

The S.P.C. reported at end of July that its 1958 construction program involving 47 miles of various sized pipelines, about half consisting of extensions to main lines and the balance laterals and distribution systems, at a total cost of $16 million, was nearing completion. Gathering systems at Hatton and Many Island Fields were completed. Main line from Moose Jaw to Regina was completed in June and the 124 mile extension to Steelman was welded out on July 20.

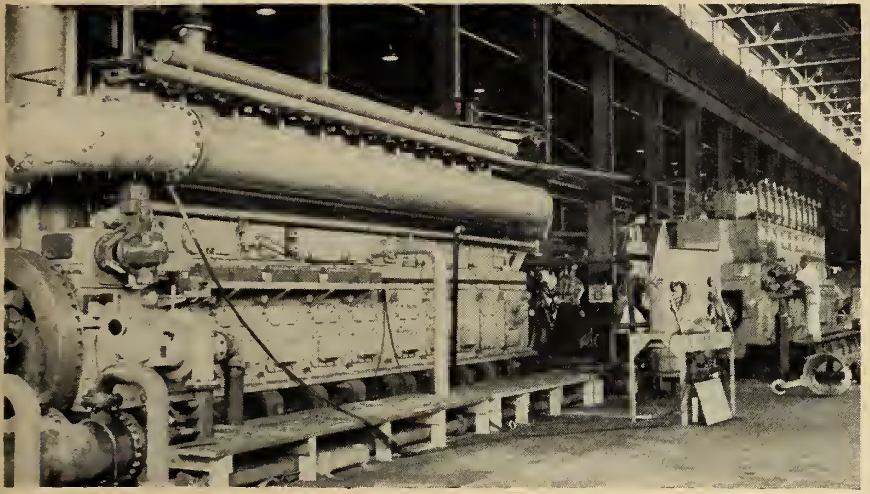
Union Gas Company:

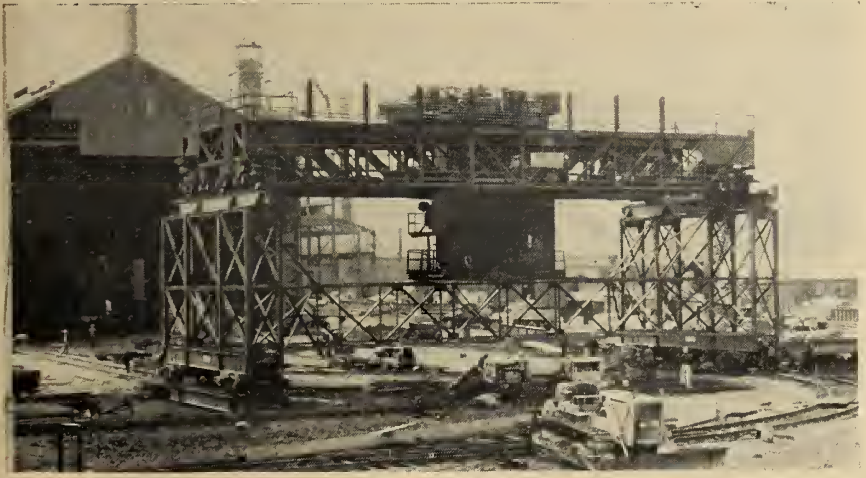
The Company's 1958 construction program consists of some 350 miles of main pipeline extensions, laterals and local distribution system footage. The work is divided about equally between new construction and extensions to existing systems. Largest single item is 45 miles of 8 inch line extending the main transmission system from Stratford to Goderich. Ten miles of 8-inch line will be laid to Amherstburg. Ten miles of 21-inch replacement line will also be laid for a new feeder between Galt and Brantford. Union will also extend the existing systems in Guelph, Waterloo and several other cities and towns and is considering adding 4,000 hp. to compressor facilities.

What Goes On

Some of the recent engineering developments are illustrated on these pages.

Right: Laboratory of the Ontario Water Resources Commission, being built at Etobicoke, Metropolitan Toronto, is designed for the future, with such equipment as an infra-red spectraphotometer for water analysis and other photometers for testing metals and gases. It is to be completed in 1959.





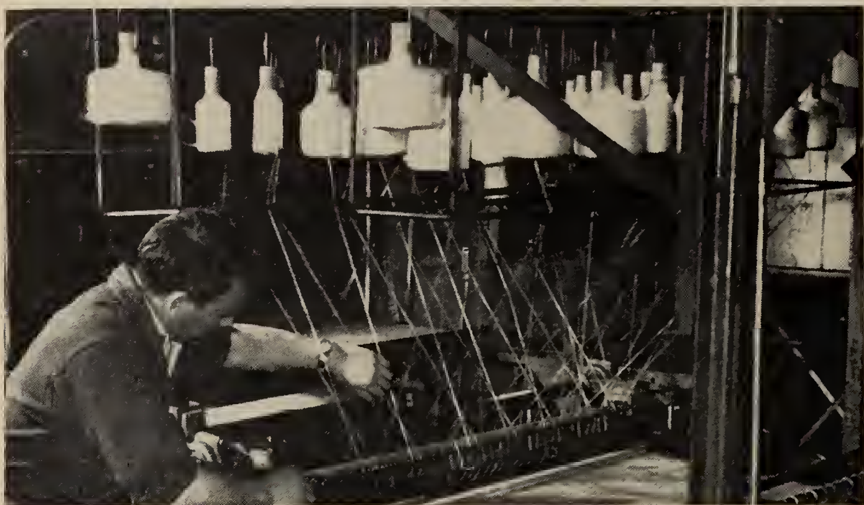
Top left. These 10-cylinder gas engines are being supplied by Dominion Engineering Company Ltd., to Trans Canada Pipeline to be installed in the first station at Burstall, Sask., and used to drive gas through the pipeline. Each engine is 30 ft. long, 12 ft. high, and weighs 120 tons, developing 3,500 hp. (at 330 r.p.m.).

Centre left. The task of moving a 360-ton stripper crane a distance of 380 feet, including a right angled turn, was accomplished by Dominion Bridge Company and Algoma Steel Company at the Algoma plant at Sault Ste. Marie, Ont. A special gantry-carrying bridge was designed and fabricated; tracks were laid between the old and new buildings, a turntable was built to carry the crane through 90 degrees, and the move was made in a down-time of 58 hours.

A vital part of the new Chute Murdock Willson power generating plant at the Ship Shaw river in Northern Quebec, is this 250-ft. high differential surge tank supplied by Horton Steel Works Limited. Price Brothers, in building this hydro power development provided an independent source of electric power.

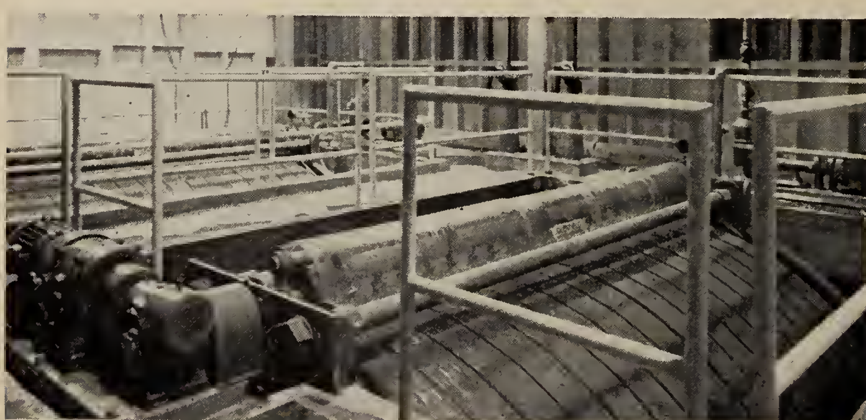
Close check is made on stator of the 12,500-kw. double extraction steam-turbo generator manufactured by Canadian Westinghouse for the Fraser Company, Edmundston, N.B.

A new bridge spans the Mattagami River at Smooth Rock Falls, Ont., designed and constructed for the Ontario Department of Highways by Foundation of Canada Engineering Corporation Ltd. The bridge forms part of the Trans Canada Highway.



Proximity to the Alberta oil and natural gas fields and the booming pipeline market, and to a readily available supply of the essential raw material, silica sands, at the Peace River sands, made possible the establishment of the Peace River Glass Company Ltd., Fort Saskatchewan, Alberta, for the manufacture of glass fibre. The operation pictured is the application of reinforcing yarn to glass fibre mat.

New headquarters of the Pulp and Paper Research Institute of Canada at Point Claire, Que., provides research facilities for approximately 200 persons.



Two micro-strainers supply 15,000 g.p.m. of filtered water to the bleach plant and machine room of the expanded chemical cellulose mill of Alaska Pine and Cellulose Limited at Port Alice, B.C.

What Goes On

New Canadian Aeroplane

The *Caribou,* the DHC-4 cargo-passenger utility type transport plane designed and built by The Dehavilland Aircraft of Canada Ltd., is scheduled to have its public unveiling this fall.

Featuring take-off and landing from limited space or improvised strips, and adaptable to military and civilian uses, the *Caribou* contains 7,000 pounds of Alcan aluminum sheet and extrusions. It will carry 28 fully equipped combat troops, will operate at a gross weight of 24,000 pounds. It has a 5,580-pound payload, over a 600-mile range, at 180 m.p.h. Using the short field technique, its take-off run is 490 feet. It will require only 770 feet to clear a 50-foot obstacle in zero wind conditions.

Length of *Caribou* 68.8 feet; height, 31.8 feet; wing span, 96 feet; capacity, gross volume, 1,000 cubic feet.

Increase in Steel Production

Dominion Foundries and Steel Ltd. has announced it will spend some $15 million on additional hot and cold rolling and finishing equipment at its Hamilton plant. The result will be an increase of flat rolling and finishing capacity by 250,000 tons.

Besides having the effect of increasing the concentration in Hamilton of Canada's steel production capacity to about 60 per cent, this will also increase the Canadian production of finished steel to more than 70 per cent of consumption.

(Abstracted from Daily Commercial News, Aug. 5, 1958)

"Buy Alberta" Program

A "Buy Alberta" program was approved in principle at a day-long conference of leaders of business, association and municipal administration in June. The conference was under the sponsorship of Department of Economic Affairs and the Department of Industries and Labour of the Alberta Government, and was supplemented by a display of some sixty Alberta-made products.

Road Spending, 1958

For the first time in Canadian history government expenditure on highways, roads, streets and bridges will top the $1 billion mark, says "Road and Wheel", bulletin of the Canadian Good Roads Association. The estimated total of $1,044.6 million, is for road construction, maintenance and administration. Provincial governments will be responsible for the expenditure of $669 million; municipal governments, $260 million; and federal government, $116 million.

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

Papers for E.I.C. Annual General and Professional Meeting, 1959

Members will be interested to know that Council has entrusted the Committee on Technical Operations (CTO) with responsibility for the preparation of the program of technical papers for the 1959 Annual General and Professional Meeting.

CTO and its Technical Divisions are responsible for the provision of leadership and the development of ideas in respect of the technical activities of the Institute. In practice, the activities of the Technical Divisions are carried out with the assistance of the Headquarters staff of the Institute which serves as the normal channel of communication for Institute business and provides the secretariat for each Technical Division, and for CTO.

The function of each Technical Division is to promote and to coordinate technical activities in its specific field and to organize its activities in such a way as to serve best that portion of the Institute membership whose work, activity and interest lie in the field covered by the scope of the Division. This is because one of the most important functions of the Institute is the dissemination of technical knowledge and experience to the membership and the advancement of the science and practice of engineering, as so well expressed in the Institute's motto:—

"To facilitate the acquirement and interchange of professional knowledge among its members, to promote their professional interests, to encourage original research, to develop and maintain high standards in the engineering profession and to enhance the usefulness of the profession to the public."

The membership of CTO, for the year 1958-9, consists of:—

C. E. Frost
Dean R. M. Hardy
A. R. Harrington
W. H. Patterson
D. L. Rigsby
E. R. Smallhorn
S. Sillitoe
B. G. Ballard—*Vice-Chairman*
F. L. Lawton—*Chairman*

The Chairmen of the six Divisions are:—

Chemical Engineering Division,
C. R. Whittemore
Civil Engineering Division,
E. R. Smallhorn
Electrical Engineering Division,
S. Sillitoe
Hydro-electric Engineering Division,
J. L. Feeney
Mechanical Engineering Division,
Prof. J. S. Campbell
Mining Engineering Division,
Prof. A. V. Corlett

Since the 1959 Annual General and Professional Meeting is being held in Toronto, the theme of the meeting is planned to bear a close relationship to the Seaway. The several Divisions of CTO have been actively planning their contributions to the program since the last meeting of CTO in May.

All members are invited to submit papers to CTO if they think the subject matter would constitute a worthwhile contribution to engineering literature. The Institute welcomes such contributions.

In order to properly plan for the necessary processing of papers submitted for Annual Meetings, CTO have adopted certain deadlines which authors are asked to observe. These deadlines are listed below.

The attention of authors is drawn to Institute standards for papers. These were printed in *The Engineering Journal* for January, 1957, on page 39, under the caption "Guide for Authors". Copies are available on request to Headquarters.

Members are reminded that the Division Chairmen of CTO will welcome suggestions for papers on subjects which fall within the scope of the individual Division. They will also welcome any constructive suggestions for future activities.

Deadlines for Annual Meeting Papers, 1959

Receipt of title of paper and name of author or authors	November 1, 1958
Receipt of abstract of paper	December 1, 1958
Receipt of manuscript	February 1, 1959

E.I.C. Annual Meeting
1959
Toronto, Royal York Hotel, June 8, 9, 10

Engineers Can Provide Direction

or

What Happened at the Birthday Party

by G. R. Henderson, M.E.I.C.
Manager, Sun Oil Company Limited, Sarnia, Ont.

Will the history books in 1999 accuse the engineers of losing the lukewarm wars of the current decade? If such an accusation should materialize—and we don't believe it will—the historian would undoubtedly record that the democracies had lost the race because of their inability to develop enough qualified engineers to solve the problem in time.

So the present educational system doesn't produce the necessary product, either quantitatively or qualitatively, and unless we neither listen to, nor believe what everyone seems to be currently talking about, we must realize that there is a shortage of trained personnel. Furthermore, industries are complaining about the calibre of the engineer who has been graduated from university after a rugged struggle through the last few years of high school and the four years of his overcrowded university curriculum.

Don't let anyone tell you that the present generation is any less sincere than their parents or their grandparents. Don't let anyone tell you that the teachers and professors are less dedicated than they were thirty years ago. Don't suggest that educators don't realize their problems, and don't believe that the boards of education are not trying to provide the necessary facilities for the ever increasing school population, while the irate taxpayer is moaning about the burden he is forced to carry.

Facts are obvious. The current graduates have lived through an era which has been more unstable than anything in history. Two wars and a constant fear of a third with a broadcasting system that delights in proclaiming the worst that could happen every hour on the hour. Together with this, the scientific progress of the last fifteen years has relegated certain physical phenomena to the obsolete files, and the present generation of graduates are expected to be able to express themselves as orators, write letters like Winston Churchill, and have a full understanding of business economics and the human relation problems involved in handling large numbers of organized workmen.

Let's face it! The youngsters of today are confronted with a much more difficult course than the grads of the twenties, and the overcrowding of secondary schools forces the teaching staff to concentrate on what they feel is their most important responsibility. The universities do not waste time on those who fall by the wayside. Talk to the young men currently in university—its a hard cold factual existence and there is no second chance.

The human race is not too different from those people about whom John Galsworthy wrote in his "Forsyte Saga". Their wants, their ambitions and their learning ability is about the same. Since that time, a few gifted individuals have changed the basic scientific concept and schools are forced to bring the curricula up to date so that the new crop of high school students will have an understanding of nuclear physics—and that isn't too simple. But when Galsworthy told his story of Soames and James and the sister who always was looking after a "lame duck", education was based on the three "R's".

Perhaps the meaning of the foregoing should be considered for a moment. In the Victorian era study was confined to the fundamentals, and the frills, including shop practice, household economics, and the various humanities were left for the development of the youngsters as they progressed into responsible life. Preceding generations depended on the apprenticeship system to teach the practical knowledge required by the specific individual and the products of these former ages were really not too bad. Newton and Watt, Shakespeare and Voltaire, Darwin and Freud, Pitt and Lincoln, Edison and Einstein are pretty good products of ancient schooling, and our own great names of the present do not seem to have suffered from the educational system even though one historian recorded that Winston Churchill didn't pass from Harrow, he climbed underneath it with the help of a tutor.

There isn't any doubt that North American schooling is based on mass education and the level of understanding of the average citizen has been immeasurably increased in the last few decades. But this doesn't necessarily produce "the greats" and the pressure system which has been developed is hard on Mr. Average North America. Consider again the educational levels—government adminstrators, boards of education, local directors, principals, teachers and students, are all under pressure trying to satisfy the demands of a public egged on by radio and television and magazines and newspapers, and our new adventurer in space "Sputnik" hasn't done anything to relieve the situation.

But enough of the problem—what is the cure—who is doing anything about it, and who is suggesting what can be done about it? The answer to the last question is probably the easiest and is answered by the simple word, "everybody". The critics and suggestors start with parents, progress through the service clubs and the boards of trade, and discussion ranges from the little groups in the home to the erudite debates of the senior governments. This discussion, however, should be cut short or the author will be criticized for trying to add "two bits worth" to the printed matter on the subject which there isn't time to read.

Common logic indicates that if the engineering education, which is necessary to produce the personnel required for national existence, is to be corrected, it should be corrected by the engineers. Who should know the problems as well? Who should be able to outline the requirements of the hungry industry and who knows better than this group the struggles and heartaches necessary to acquire the parchment which declares that the holder has been awarded the degree of bachelor of applied science or some other similar description.

There was a birthday party recently in one of the large New York hotels at which the head waiter carried in a huge cake decorated with twenty-five candles. He walked too rapidly and the candles went out, but a match repaired the damage and the party was a huge success. What did it celebrate? Oh you should have been told before. It was the twenty-fifth annual meeting of the Engineers' Council for Professional Development and the initials "ECPD" have been used to set up the title of this discussion. The birthday party was a combined meetwith the Engineers Joint Council and the presidents of all the national engineering societies graced the head table. It is suggested that their presence was a tangible expression of a unity of purpose and a desire to provide guidance and help to our future generations of young engineers.

This article is being written because of the lack of knowledge and understanding of the work and progress being made by the men who constitute ECPD and its hard working committees. No explanation could be as effective as the introduction of the 25th Annual Report of ECPD submitted by the president, M. D. Hooven.

"After twenty-five years of expanding operations of the Engineers' Council for Professional Development, no drum beating is needed to draw attention to the success it has achieved. More in order, perhaps, is an acknowledgement of the tremendous contributions that are made to ECPD, largely in voluntary individual services, but also in terms of money. ECPD is a federation of engineering societies, which does the specific job of sponsoring the intellectual development of the individual engineer. It carries this responsibility in the United States and Canada with the general support of all engineers and engineering societies although its formal organization encompasses only eight bodies".

"ECPD's most valuable help comes from the contribution of time and interest by individuals widely dispersed geographically and hundreds of engineers have contributed their time and thought. Because of this large voluntary effort, the general operating expenses are almost unbelievably low—".

Committee activities include the guidance given some two hundred thousand students during the last twelve months — 1800 schools were visited and amongst other activities, 2000 speakers were provided for interested groups.

Studies and conclusions have been presented concerning the development of the students and these encompass such current problems at "Attrition in the Engineering Schools". The report outlines the vital need for careful selection of students and the overall advisability of retaining the trained engineer on engineering work, so vital to our national existence.

However, no attempt is being made to duplicate the annual report and the foregoing illustrations only serve to outline the findings and recommendations of the men who have studied these problems throughout the length and breadth of the land.

Perhaps the outstanding work of ECPD is the accreditation of university curricula by teams organized into geographical districts so that universities who request recognition of their various curricula can be visited by qualified individuals. It isn't surprising that most of these teams are made up of men from the teaching profession, and many are deans of the science faculties. These men enthusiastically attempt to provide help and guidance for the institutions they visit.

All types of problems are discussed from the administration of the school to details of the curricula. Studies have been made by these groups in analysing all problems confronting the engineering schools, together with suggested curricula which tend to standardize at an optimum level the training given to undergrad students.

universities who request their accreditation. Nevertheless, this statement, taken at face value, indicates the recognition already given to the endless task, and the nation should be eternally grateful to the group of men who have given unstintingly of their time for the advancement of engineering education.

If the reader will be patient for a few more minutes, it would be well to outline the contribution made by a relatively small group, to the engineering educational conferences covering western Europe and North America. The organization is known as "EUSEC" and three sessions have been held during the past seven years. ECPD was requested to represent the North American engineering societies and their choice proved excellent. The report on engineering education in the United States, prepared by ECPD and submitted to the Paris Conference in September, 1957, has received widespread acclaim for its clarity and thoroughness.

It is almost a limitless task to appraise the difference of the educational systems in all the countries represented at the EUSEC conferences, but it is obvious that fundamentals of an engineering education are unaffected by international boundaries. The profession, the practicing engineers, and the world, all will benefit from a universal training of engineers and the subsequent common background to enhance the interchange of knowledge for the benefit of man's development.

But it is time to return to the birthday party, and no excuses are offered for the lapse into a record of achievement of which ECPD should be justifiably proud.

At a luncheon during the annual meeting, the guest speaker, an eminent educationist, outlined with convincing clarity, that the university he represented had already embarked on curricula which deleted practical instruction from the undergraduate years and taught as much mathematics and physics as possible during that time. He reviewed what he considered the fundamental requirements of the engineer and lucidly outlined the impossibility of digressing from this principle, because of the limitations of hours available during the four years of the undergraduate's life. At the same time, he outlined how much easier and more effective was

The author is one of the three representatives of The Engineering Institute of Canada on the Council of ECPD. The two other representatives are Dr. Otto Holden and Col. W. S. Wilson.

A recent article in the *Saturday Evening Post* describes the procedure of a recruiter for a major industry. This man is quoted as follows:

"Last year a mere 26,306 bachelor degrees were awarded by the nation's 213 engineering schools, of which only 153 had one or more of their curricula accredited by the all powerful Engineers' Council for Professional Development".

It is doubtful whether any of the accrediting teams would regard themselves as belonging to an all powerful group, and as stated before, it is with a spirit of co-operation that they visit the practical training which could be given to the new engineer when he entered specific engineering organizations.

Following the luncheon, four speakers representing widely diversified industries, outlined their procedures for training peculiar to their own industry, together with post-graduate education for recent graduates. One major industry employs graduates with the understanding that they will obtain additional academic credits equivalent to two full years of university standing. In this particular instance, adequate accommodation and resident professors from an accredited university, are provided at the plant. All tuition is paid by the company and the students are allowed approximately twenty per cent of their normal working week for attendance at the formal school classes. The other examples outlined during the afternoon, were variations of the same principle and all these industries provide time and money for post-graduate study. Furthermore, and most important, the men who are fortunate enough to be included in these programs were given full university post-graduate credits for all successfully completed work.

So much for the birthday party. The guests departed for their homes located in widely dispersed areas of the United States and Canada. Next year most of them will return and report what has been accomplished during their extracurricular activities, and who knows what their influence will produce during the next twenty-five years.

In retrospect, the birthday party indicates a trend, and one that is developing rapidly. It is impossible, and probably undesirable, to divorce engineering education from the general course of the secondary schools. This discussion has been specifically concerned with the undergraduate training of the engineer, but it is fully appreciated that the other professions and the very important study of the humanities are equally important to our progressive development. It is generally conceded that students who enter university for the purpose of studying any of these vocations have not acquired the training which the universities would like them to have and there is an indication that the essentials have been curtailed in an attempt to increase the breadth of education by the very desirable, but somewhat unnecessary, information which overloads the courses of study.

It seems to be impossible to make pseudo historians or writers of potential engineers, just as much as it is impossible to reverse the process. Members of the present generation entering university have a broad appreciation of the direction in which they are heading and that it would appear impossible to stop the development of the youngsters toward the vocation they set for themselves. At a recent luncheon speech, the speaker eloquently and forcefully presented a program of health education and requested a very few hours of the secondary school term for enlightenment on the important subject. The director of education for the municipality listened to the discussion with considerable interest, but as he walked out he remarked "Norman was convincing, but this is just another suggestion to work into a term already much too overcrowded".

Industry recognizes that when workers are under continuous pressure, the unit of production falls off. What then can be expected from our schools? A halt should be called to the "rat race" and the courses should be reduced to an essential minimum. Eliminate options in the academic courses and permit the students to take additional subjects, if they have the ability, and as a reward for academic proficiency—but clearly outline to the students and parents the requirements for university entrance when the child enters secondary school. Children of fourteen are really much too young to have any conception of what they would eventually like to do—and those few who have a burning desire don't require direction, so why worry them. These are the years which are much too short—when they should be keen about sports and parties with lots to eat, and movie stars and jazz singers — why try to make them decide their future forever and ever when they all know for certain that they are going to be presidents or prime ministers. Conclusion — teach the three "R's" adapted to 1957 but allow time and exhibit patience enough to make a good job of it.

It is suggested that the universities would welcome the students from a simplified standardized secondary school system and their responsibility for selection of students, and the training of undergrads would be immeasurably simplified. First year university to-day is almost a review of the last year of high school.

The most qualified persons to set up our educational standards are undoubtedly those who have been trained for the work. It is difficult to visualize anything more confusing or frustrating than to have home and school clubs or parents and teachers

(Continued on page 177)

Elections and Transfers

A number of applications were presented for consideration and on the recommendation of the Admissions Committee, the following elections and transfers were effected at a meeting of Council on July 18, 1958.

Members: C. R. E. Allen, Montreal; D. F. Caveen, Rimouski; H. R. Edwards, Arvida; D. Eyres, Montreal; E. Godard, Montreal; J. T. Gregg, Toronto; K. Hailstone, Montreal; D. L. Harris, Montreal; J. M. H. Heines, Montreal; J. E. Hillier, St. John's; C. W. Hodgson, Toronto; G. A. Johnson, Toronto; H. P. Kerstens, Woodstock; W. Kitson, England; G. J. Lane, Baie Comeau; D. B. Nazzer, Toronto; P. S. Mani Sandaram, Halifax; J. M. Stevens, London; R. C. Warren, Toronto; F. E. Winter, Montreal.

Juniors: D. L. Anderson, Edmonton; R. W. Barker, Sault Ste. Marie; J. B. Couderc, Montreal; P. R. Hart, Port Hope; M. Marenghi, Arvida; R. R. Muirhead, Sudbury; N. R. G. Paget, Victoria; V. S. Pendakur, Port Hardy; A. J. Powell, Montreal; P. J. Pride, Shawinigan.

Affiliate: R. E. Fischer, New York.

Junior to Member: W. B. Arnold, Toronto; B. E. Babcock, Kingston; L. Bell, Winnipeg; R. M. Benjamin, Bathurst; N. S. Hepburn, Victoria; J. R. McWhinnie, Windsor; J. E. Ste. Marie, Montreal.

Student to Member: D. M. N. Smith, Scarborough.

STUDENTS ADMITTED

McGill University: R. S. Duquette; U. Thaung Sein.

University of Toronto: B. Wolchak.

St. Francis Xavier University: E. Lukan.

Loyola College: P. Tang.

A.P.E. Ontario Students: R. Colthoff; R. H. Patterson.

Graduates: J. F. Baird, B.Eng. (Elec.), N.S.T.C., 1958; O. Grieco, B.Eng. (Chem.), McGill University, 1958.

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members: G. L. Colborne; G. E. Golden; J. C. S. Heathcote; R. L. Higgins.
Junior: B. A. Donnellan.
Junior to Member: I. D. Finnan.
Student to Junior: C. N. Ellert.

SASKATCHEWAN

Members: R. H. Clarke; E. J. Cuyler; G. M. Greenwood; G. M. Hasegawa; A. A. Janusz; B. Marosi; W. B. Reed; W. Stichling; B. S. Wheeler.

Students: R. S. Forrest; L. J. T. Pollock.

Junior to Member: F. K. Gerbrandt; T. P. Gilchrist; J. A. Haynes; H. G. Kindred; P. Kozicki; N. E. Parsons; G. A. Patterson; A. C. Schuster; W. J. Serne.

Student to Junior: A. M. Campbell; F. W. Fossey; D. A. Meneley; J. H. Peterson.

NOVA SCOTIA

Member: R. J. Richard.

MANITOBA

Member: W. H. Mitchell.
Junior to Member: W. J. Ducharme.

Professional Development Courses

sponsored by The Engineering Institute of Canada

are available at the following Branches:

HAMILTON BRANCH

The Professional Development Program, Hamilton Branch, will be a four-year co-ordinated program covering such non-technical subjects as Public Speaking, the Humanities, Law, Government, Financial Control, Business Management, and Human Relations. The initial years use the lecture and discussion method extensively, while the case study method is used in the more advanced years.

Registration night will be Wednesday, September 17, 1958, at 8.00 p.m. at the Royal Canadian Artillery Mess of the James Street Armouries. The fees for Groups 1, 2, and 3, are $12.00 for E.I.C. members, and $15.00 for non-members. Group 4 fees are $27.00 for E.I.C. members, and $30.00 for non-members. To obtain a brochure and registration card, interested people should attend registration night or contact J. A. Walsworth, at LI. 9-3095 or FU. 5-8902, Hamilton.

NIAGARA PENINSULA BRANCH

The Niagara Peninsula Branch presents a Professional Development Program as a four-year course designed to develop self-confidence and afford the participant an insight into the world of Human Relations and Modern Business Management.

Registration night will be Tuesday, September 23, 1958, at 8.00 p.m. at the Sir Adam Beck Power Station Assembly Hall, Queenston. Registration cards are being mailed out to all engineers in the area and will also be available on the evening of registration.

SARNIA BRANCH

The Sarnia Branch of the E.I.C. will sponsor a fall program consisting of an eight-week course based on Canadian Economy. Four lectures will be given by professors of the Department of Economics of the University of Western Ontario, and four lectures by representatives of industry and labour.

The first lecture will be held on Thursday, October 2, 1958, and the course will continue on succeeding Thursdays. Registration cards are being sent out to all local engineers and can also be obtained on the first evening of the lectures.

TORONTO BRANCH

The Professional Development Program for the Toronto Branch this year will be a four-year course, revised to provide increased participation and improved continuity from year to year. The program covers Personal Development, Business Environment, Social Environment, and Human Relations.

Registration night will be Tuesday, September 30, 1958, at 7.30 p.m. at the 48th Highlanders Hall, 519 Church Street, Toronto. Advance registration forms can be obtained and this is advisable as numbers are restricted. For information please contact, W. W. Walker, at HI. 4-6424, or the E.I.C. Office at HU. 7-0221.

The following Branches will also have Professional Development Programs and details are available by contacting the men listed below:

BROCKVILLE, ONT.: D. B. Ashenden, c/o Phillips Electric Co. Ltd., Brockville, Ont.

LONDON, ONT.: W. C. Simkins, c/o London Steel Construction Company, P.O. Box 69, 48 Burslem Street, London.

SAINT JOHN, N.B.: G. C. Robinson, P.O. Box 824, Saint John.

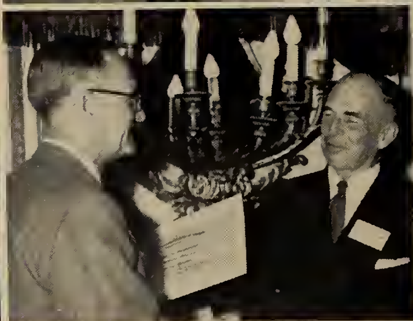
ST. MAURICE VALLEY, QUE.: J. O. Hachey, 53 Spruce St. (Apt. 13), Shawinigan Falls, Que.

SAGUENAY, QUE.: D. L. Aker, 309 Racine Street, Arvida, Que.

VANCOUVER, B.C.: T. H. White, 2461-51st Ave., Vancouver 14.







Awards of The Engineering Institute for 1957

Six honorary memberships were announced at the 1958 annual meeting of the Institute, and thirteen awards of medals and prizes, as listed in *The Engineering Journal*, June, 1958, Page 87. Awards were made at the annual meeting to those who could be present, and the presentations by President C. M. Anson are recorded here: *Above*: Newly created honorary members: Sir Claude Gibb, The late Dr. P. L. Pratley, Dr. I. R. Tait, and Dr. E. O. Turner. Photograph of Dr. Armand C. Crepeau, HON. M.E.I.C., was unfortunately not available for this issue. For photograph of Dr. L. Austin Wright, HON. M.E.I.C., please see June *Journal* Page 88.

In the right hand column: Julian C. Smith medal winners, R. E. Jamieson, and Dr. R. E. Heartz; and first winner of the Robert W. Angus Medal, R. J. Kennedy, as he receives the award from Robert W. Angus.







Left to right, Award winners: Robert David, G. G. Meyerhof, Dr. Martin Griffith (accepting for his father, R. G. Griffith), Wilfred Pegusch, E. O. Lilge, Dr. H. R. L. Streight, and C. M. Stewart.

E.I.C. Awards, 1958 (Continued)
Left to right: Award winners R. D. Neill, Gilles Gagnon and D. A. Chamberlain.

IAESTE 1958

This year for the first time since Canadian participation began, the number of IAESTE students coming to Canada has shown a decline from the previous year. It is believed that this has been due to two principal causes. First the general business recession now being felt in Canada and, second, the fact that several projects of national importance involving engineers have come to an end within a few months of each other, thus temporarily satisfying the immediate demand for engineering manpower. Events of this kind must be expected to have an adverse effect on summer employment for undergraduate engineering students.

On the other hand, it has been most encouraging to note that the number of Canadians participating in IAESTE who went abroad for summer training this year has doubled any previous year. The causes for this increase may of course be the same as those outlined above. Nevertheless the effect has been good so far as Canadian interest in the exchange plan is concerned. Inquiries by Canadian students reached a new high of about 50 odd applications, and this undoubtedly has been largely due to the splendid work done by many of our E.I.C. Faculty Advisers.

Referring to the actual figures for the 1958 exchange, we have provided places for 94 European students from 11 countries with us in Canada, and in the other direction 25 Canadians have accepted offers in 10 different countries of Europe. These figures may, of course, be subject to slight revision, due to a few possible additions late in the season. If the total participation in both directions is compared with the same total for last year, it can be noted that the overall drop for 1958 is only about 12%. Considering the factors affecting the operation of the plan this year this is not too discouraging.

Collection of funds to continue the Canadian IAESTE Travelling Bursaries was also difficult this year and one must assume the same basic reason again, that is, general business conditions. The result has been that the individual amounts granted have had to be drastically cut. With more Canadian students participating, and less money available, there was no alternative. This problem will have to be faced squarely by the Canadian Committee before we embark on another year's operation. At the same time it was felt that the Canadian students were extremely grateful for the assistance they did receive.

Earlier in the year, E. C. Luke of Institute Headquarters had the privilege of attending the IAESTE Annual Conference in Madrid, as secretary of the Canadian Committee. This was a profitable and instructive experience. Mr. Luke learned a great deal about the operation of the plan in Europe and met many of those other officials, for the first time, with whom he has been working for the past several years. Visitors to Canada this year were Mr. James Newby and Dr. H. V. Walters, both of the IAESTE Committee for Great Britain, of which Mr. Newby is still executive secretary. They spent several weeks in Canada during July visiting Montreal, Ottawa, Winnipeg, Edmonton, and Toronto on general IAESTE promotion.

As a final item of interest it has been noted that some important statements about IAESTE have come out of a report by a Working Party on Scientific and Technical Personnel under the Organization for European Economic Co-operation. This report, dated in Paris October 21st, 1957, states "The mission found the work done by IAESTE in organising the inter-change of technical students among various countries extremely valuable, and strongly recommends that O.E.E.C. support this work." It is hoped that Institute members, and other Canadian industrial leaders, will continue to feel the same way about it.

DID YOU KNOW THAT

The E.I.C. Library handled approximately 25 enquiries a day in 1957; and supplied more than 3,000 items to some 500 members.

Nuclear Congress, 1959

Canadians Invited to Present Papers in Nuclear Field

The fifth Nuclear Congress will be held in Cleveland, Ohio, April 5-10, 1959. The general theme of the congress will be "For Mankind's Progress".

The Congress will be made up of four major activities: (a) Nuclear Engineering and Science Conference, (b) Atomic Energy Management Conference, (c) Hot Laboratories and Equipment Conference, (d) Atomfair.

The Engineering Institute of Canada as a sponsoring society, is responsible for obtaining technical papers for the Congress.

Authors are invited to submit summaries (300-500 words) of proposed papers. October 1, 1958 is the deadline for receipt of summaries at E.I.C. Headquarters for transmission to the Congress Manager.

Authors will be notified in October of selection of papers for the program, and will be given specifications for the preparation of manuscripts, to be received by the E.I.C. by November 28.

Interested authors should send summaries to: Dr. Garnet T. Page, general secretary, The Engineering Institute of Canada, 2050 Mansfield St., Montreal 2, Que.

THE ENGINEERING INSTITUTE OF CANADA

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OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

T. A. McGinnis, M.E.I.C., of Kingston, Ont., president of McGinnis and O'Connor, contracting engineers, died at Kingston, on June 18, 1958.

Thomas Alexander McGinnis was born in the Ontario town of Belleville, on April 9, 1887. He attended Queen's University and attained a B.Sc. degree in 1909. Some of his first engineering experience was gained with the Canada Cement Company Limited and the Missisquoi Marbles Limited. In 1918 he became the senior partner in the firm of McGinnis and Connor. He carried out highway construction for the Province of Ontario.

He retained his close connections with Queen's University throughout his career and was in 1955 awarded an Ll.D. from that institution. He was a member of the board of trustees of Queen's and the Queen's University Council. He was also chairman of the university's building committee and was one of the leading figures in postwar construction at the institution.

He also served as superintendent of construction for Lehigh Portland Cement Company, (Canada), and construction engineer for Canada Cement Company until he finally formed his own firm.

Mr. McGinnis joined the Institute as a Student Member in 1908, transferred to Associate Member in 1912 and to Member in 1923. He attained Life Membership in 1947.

P. C. Kirkpatrick, M.E.I.C., of Montreal, died at his home at Baie d'Urfee, Que., on June 30, 1958.

Paul Chester Kirkpatrick was born at Parrsboro, N.S., on November 13, 1889. He attained a B.Sc. degree in civil engineering from McGill University in 1916. His long and varied engineering career began with the Dominion Bridge Company Limited, Montreal, shortly after his graduation, with the post of assistant metallurgist. The following year he worked with Fraser Brace and Company Limited. The association continued for a great many years. Mr. Kirkpatrick was involved in the building of a number of major projects including the building of the Gouin Dam, St. Maurice River, Que., the Great Falls Power House on the Winnipeg River, the Island Falls Power House, Abitibi River, the Deer Lake Power House, Nfld., the Abitibi Canyon Development, and the extension to the International Nickel refinery at Port Colborne.

During World War II Mr. Kirkpatrick was resident engineer for H. G. Acres and Company, consulting engineers of Niagara, on the Shipshaw power project. In 1947 he was sent by that firm to South Island, New Zealand, to explore a site for producing power.

Within the last few years Mr. Kirkpatrick had been involved in projects for the Quebec Iron and Titanium Corporation, the Dufresne Construction Company, The St. Lawrence Seaway Power development, Cornwall, Ont., and the Campbell River, B.C., power development for the firm of H. G. Acres.

Mr. Kirkpatrick joined the Engineering Institute as a Student in 1915, became an Associate Member in 1919 and a Member in 1940. He attained Life Membership in 1954.

H. O. Keay, M.E.I.C.

H. O. Keay, M.E.I.C., retired manager of the research laboratory, Consolidated Paper Corporation Ltd., Three Rivers, Que., who died at Sudbury, Ont., on May 14, 1958.

An obituary item appeared in the July issue of the *Journal*.

Robert James Gibb, M.E.I.C., retired official of the City of Edmonton, died in that city on May 14, 1958.

Born at Kinross, Scotland, on May 1, 1897, he attended the George Watson's College and the Herriot Watt Technical College at Edinburgh. In 1895 he began a four-year apprenticeship in Edinburgh with a civil engineer. At the end of that time he took over the post of resident engineer on dock work with trustees of the Clyde Navigation, Glasgow, Scotland. Named agent and engineer for the J. Urquhart Contracting Company at Uddington, Scotland in 1902, he was resident engineer and assistant engineer in the bridge construction, for the Grand Trunk Pacific Railway. Moving to Canada he assumed charge of work in the sewer and water department at Edmonton, in 1913 under the city engineer. He was named assistant city engineer in 1915. This was followed by the appointment of city engineer and superintendent of waterworks. In 1936 Mr. Gibb became third city commissioner of that city, having charge of public works and civic utilities.

A Life Member of the Institute Mr. Gibb joined the E.I.C. as an Associate Member in 1910, and transferred to Member in 1914.

Major H. E. Maple, V.D., M.B.E., M.E.I.C., retired military engineer, of Ottawa, died in that city a number of months ago.

Harold Ernest Maple was born at Brighton, England, on July 3, 1883. He attended the School of Science and Art at Brighton, later followed a three-year course in architecture, and devoted two years to the study of military engineering and surveying, at Chatham, England. He moved to Canada in 1903 to accept the post of assistant instructor, survey and military engineering, at the Royal Military College, Kingston, Ont. Three years later he began work on a militia survey, 1906 to 1911. During World War I he was engaged in the general construction of a number of armouries across Canada. He continued at the same time to carry out instructional duties in military engineering. Later he became a superintending engineer with the Department of National Defence, Ottawa.

Most recently he held the post of chief engineer, Q.M.G. Branch, Army, Dominion Government, Ottawa.

Major Maple was an Associate Member in 1917, transferred to Member in 1940, and attained Life Membership in 1954.

G. E. Templeman, M.E.I.C., of Montreal, chief engineer for the City of Montreal, electrical commission, died in that city on May 30, 1958.

George Earl Templeman was born at Waubaushene, Ont., on June 26, 1879. He attended the School of Practical Science, Toronto in 1896-1897. He was engaged in construction work with Allis Chalmers Bullock, and with the firm of Dietrich Ltd., early in his career. In 1915 he joined the City of Montreal, electrical commission. Two years later he was named to the post of chief engineer in the organization. On his retirement in 1954 Mr. Templeman was made a member of the Commission.

For eighteen years he was a member of the City Council, Montreal West.

Mr. Templeman joined the Engineering Institute as an Associate Member in 1919, and transferred to Member in 1927. He attained Life Membership in 1950.

Major H. B. MacConnell, M.E.I.C., retired engineer, of the Barnett-McQueen Construction Company, Fort William, Ont., died in that city on July 2, 1958.

Howard Bruce MacConnell was born at Springbrook, Ont., on August 14, 1886. He attended Albert College, Belleville, Ont., and obtained engineering qualifications through studies with the International Correspondence Schools, and the Chicago Millwork Bureau. Beginning his career in 1908 he worked for the first few years on railway construction in Eastern Canada. During World War I he served with the Canadian Army. A millwork estimator at Detroit from 1923 to 1927, he became a certified millwork estimator in 1924. For a great many years Major McConnell conducted a private contracting business throughout Ontario. At the end of the depression era of the 1930's he became associated with the firm of Barnett-McQueen Construction Company in 1938, and was a member of the engineering staff for a period of twenty years, until his retirement at the close of 1957. For the past few months Major MacConnell had been associated with the firm of Mickelson, Fraser and Haywood, engineers and architects, Fort William, as a field inspector. Major MacConnell joined the Engineering Institute as a Member in 1923.

H. W. Furlong, M.E.I.C., of Wollaston, Mass., retired structural and consulting engineer with Stone and Webster, Inc., Boston, died there on May 30, 1958.

Henry Walter Furlong was born on June 16, 1888, at Guildford, Eng., and attended the University of London, where he acquired a B.Sc. degree in 1908. That year he became associated with the firm of Mssrs. G. H. Williams and Son, sewerage engineer, London.

Transferring his engineering skills to Canada in 1909 he went to work for the Toronto firm of Unwin, Murphy and Esten, surveyors. From 1909 to 1915 he was associated with the Dominion Bridge Company Limited, Montreal, in various posts. In 1915 he joined the Canadian Government Railways, now the Canadian National Railways, at Moncton, N.B., and continued in this work until 1920. He became an assisant engineer with Stone and Webster Inc., industrial engineers, at Boston, in 1920.

In 1934, he was briefly with the staff of Sir Alexander Gibb and Partners, London, Eng., but returned to the staff of the Stone and Webster Engineering Corporation the following year.

He continued to serve Stone and Webster Inc., until his retirement in 1953.

Mr. Furlong joined the E.I.C. as an Associate Member in 1924, and became a Member in 1940.

Axel L. Oddleifsson, M.E.I.C., of Winnipeg, died in that city on May 28, 1958.

A native of Winnipeg, Mr. Oddleifsson was a graduate of the University of Manitoba, where he attained a degree in electrical engineering in 1931. His early experience included service as a junior engineer with the Winnipeg Electric Company on the Seven Sisters Falls, and as electrical engineer with the Manitoba hydro-electric board. Later he was superintendent of the Pine Falls generating plant; in 1953 he was named assistant to the manager of the operating division of the Winnipeg Electric Company.

Mr Oddleifsson joined the Engineering Institute as a Student Member in 1929. He transferred to Junior in 1936 and became a full Member in 1943.

Franz Joseph Marie Raskin, M.E.I.C., of Montreal, founder and president of the firm of F. J. Raskin Incorporated, combustion equipment manufacturers and power plant specialties, Montreal, died at Montreal on November 29, 1957.

Born at Modave, Belgium, on April 14, 1900, Mr. Raskin received his general education in that country and moved to Canada in the early days of World War I. His first work was that of apprentice in the Montreal shops of the Grand Trunk Railway. He was employed in the munitions field in World War I. In 1918 he accepted work with the Abitibi Pulp and Paper Company research department, Iroquois Falls, Ontario. In 1919 he enrolled at McGill University, faculty of applied science, and continued throughout the second year. Obliged to pursue his studies as well as earn a living during the next few years, he was associated with the Canadian Pacific Railway, design department, at Montreal, and the Lake St. John Power and Paper Company in 1926. He became a designer and estimator for heavy mechanical equipment in 1928. Later he was associated with the consulting engineering firm of Messrs. Wilson and Jas. A. Kearns. In 1932 he acquired the legal qualifications to enable him to practice engineering.

F. J. Raskin, M.E.I.C.

The present firm of F. J. Raskin Incorporated was founded in 1932.

Mr. Raskin joined the E.I.C. in 1945 as a Member.

Edwin G. P. Lang, M.E.I.C., of Montreal, died on June 23, 1958.

Born in England, at Winbledon, on March 5, 1896, Edwin George Power Lang attended the Royal Military College at Sandhurst, England, the Croydon Polytechnic, London, and the Stanley Technical, London, and undertook university courses in highway and municipal engineering and economic geology. In 1924 Mr. Lang accepted a post with the C.N.R. as an instrumentman at Montreal, and during the next ten years gained experience also with the Shawinigan Engineering Company, Montreal, and the Canadian Car and Foundry Company. In 1935 and 1936 he was engaged in private geological investigations. This resulted in the post of geological investigator with the Canada Cement Company, Montreal, and Toronto. In 1940 he became senior assistant engineer with the Department of National Defence. Throughout the war, from 1941 to 1945 he served as a works officer in the capacity of a flight lieutenant, D.N.D., for Air, at Montreal and Moncton. At war's end he transferred his services to the Canadian Pacific Railway, Montreal, as construction engineer. Later he was associated with the Hydro Electric Power Commission of Ontario on tunnel development. In 1948 he was associated with the Aluminum Company of Canada Limited, Montreal.

Mr. Lang joined the Engineering Institute as a Member in 1947.

Michael Sylvester Kennedy, M.E.I.C., of the Department of Highways, construction branch, Victoria, B.C. died at Victoria, recently.

Mr. Kennedy was born at Quyon, Que., on January 24, 1896. He attended high school in Ontario. His engineering career began in Saskatchewan where he was associated with the provincial government as rodman, instrumentman and resident engineer with the department of highways from 1921 to 1935. From that time until 1948 he served as district engineer for the department. Transferring his services to Alberta, in 1949, he became project engineer, for the Eastern Rockies Forest Conservation Board. Two years later he moved to the Department of Public Works, highway division, at St. John's, Nfld. In 1952 he assumed the post of resident engineer, with the Province of British Columbia, construction branch, Department of Public Works, at Victoria.

Mr. Kennedy joined the Institute as a Member in 1949.

R. A. W. Bond, JR.E.I.C., of the firm of H. G. Acres and Company Limited, died in an accident at work a number of months ago.

Raymond Arthur William Bond was born on July 3, 1922. He studied engineering at London, England, and graduated with a B.Sc. degree in engineering in 1949. Moving to Canada at that time he accepted employment with the Foundation Company of Canada Limited. The following year he was associated with the firm of Sproston's (Jamaica) Ltd., Jamaica, B.W.I. In the years which followed he was associated with the Montreal Engineering Company at Chicoutimi, the Canadian International Paper Company at Hawkesbury, Ont. At the time of his death he was engaged in area engineering for the powerhouse at the Chute-des-Passes hydro-electric project of the Aluminum Company of Canada Limited.

Mr. Bond joined the Engineering Institute as a Junior Member in 1950.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

MANITOBA

(Taken from the Manitoba Professional Engineer, June issue, and written by L. A. Bateman, P.Eng.)

The President's Message

"Your Association is continuing to enjoy a healthy growth as more of the eligible engineers are being registered. The work of Council never seems to decrease despite the increased number of committees that have been appointed this year. I would like to review the work of some of these.

Our public relations committee has been most active, theirs is a continuing job of attempting to improve the status of the professional engineer in the community. They also have several projects underway, of which we shall hear more later.

The chairmanship of the night university committee was turned over to your past president, who has been doing a good job. A council, along with this committee, had a meeting with the University Senate to explore the problems of establishing credited night courses in engineering. This will be reported on more fully later.

The sports committee, under the chairmanship of Harry Benditt, had a very good turnout to the spring golf tournament and you will read of this elsewhere on these pages. It is hoped that the fall meet can break the record again.

The advisory committee has been reconstituted under the chairmanship of Mr. M. A. Roche and has been assigned the important task of investigating permanent quarters for your Association. We would like to know what you think about this problem and whether you are in favor of establishing permanent quarters, and any suggestions you might have on how such a program would be financed.

The writer and Mr. Bubbis attended the annual meeting of Canadian Council in Vancouver. Mr. Bubbis was again elected an executive member of Canadian Council. Next year, on invitation from your Council, the Canadian Council meeting will be held in Winnipeg, the dates have not been settled as yet. This will provide an opportunity for Winnipeg engineers to sit in on some of the deliberations and learn of the very important work that is being done on a Dominion basis for our profession. The last meeting of Canadian Council held in Winnipeg was in May, 1950, and many will recall our excess moisture at that time. The meeting was postponed until the fall of that year.

This year following the pattern that was inaugurated last year of visiting some of the outlying areas where professional engineers are located, who have difficulty in attending our Annual Meeting, Council is planning a visit to Camp Shilo, Brandon and Virden, Man. Just as in the case of Council's visit to Flin Flon last year, it is hoped that a down-to-earth meeting can be held with groups in the areas referred to, in order that the work of Council on behalf of the members can be reviewed. It is hoped that non-registered engineers in areas referred to can attend these meetings."

BRITISH COLUMBIA

(Taken from the B.C. Professional Engineer, July issue.)

Nominating Committee Elected

This spring members of the Association elected a Nominating Committee for the Association. This Committee is charged with the responsibility of providing a slate of nominees for election to the 1959 Council of the Association. It is composed of the following members: civil: T. V. Berry, H. R. Wooster; electrical: L. B. Stacey, M. A. Thomas; mechanical: P. N. Bland, W. O. Richmond; mining, geological and metallurgical: D. F. Kidd, A. D. Turnbull, chemical: C. A. Moore; forest: W. Hall; structural: R. A. McLachlan.

The committee was elected from candidates nominated at the 1957 Annual Meeting, and it will meet for the first time between the dates of September tenth and seventeenth as provided for in the By-laws of the Association. In the event that a group of members wishes to nominate someone for Council in addition to those nominated by the Committee, provision is made in the by-laws for the committee's nominees to be published during the month of October, and for nomination to be made in writing by twenty-five or more members not later than November 1st.

If any members have nominees to suggest to the Committee, the members of the Committee would appreciate being contacted before September tenth.

Gold Medal Award

At the meeting of Council on June 18, President G. C. Lipsey, P.Eng., presented the Association Gold Medal, awarded annually to the graduating student at the University of B.C. with the best record in four years of applied science to T. A. Nordstrom, a 1958 graduate in electrical engineering. Normally this presentation is made at the annual meeting, but as Mr. Nordstrom is leaving for England in August on an Athlone Fellowship, it was made at this time.

ONTARIO

Engineers in the News

J. David V. Adams, P.ENG., has accepted a position as engineering co-ordinator with Cockshutt Farm Equipment Co. Ltd., in Brantford, Ont. He recently obtained master's degree in business administration at the University of Western Ontario, London, Ont.

Dr. Franc R. Joubin, P.ENG., Toronto consulting geologist, and **Donald H. James**, P.ENG., of his staff, have returned to Canada following the completion of a study of the uranium resources in Sweden for Swedish clients. They report that the Swedish people are making considerable progress towards producing their own domestic requirements of uranium oxide.

Major J. H. Gillett, P.ENG., of the Canaadian Army has completed the U.S. Army Command and General Staff Course at Leavenworth, Kansas, and has resumed work allied with communications engineering as production expeditor and co-ordinator at NATO headquarters in Paris, France.

Ernest C. Shirazee, P.ENG., is with Avro Aircraft Ltd., Malton, Ont., in the capacity of a service engineer. He was formerly employed by the Minnesota Mining and Manufacturing Co. of Canada Ltd., in London, Ont.

Arthur A. Webster, P.ENG., who is employed with the Public Works of Ceylon, Columbo, Ceylon, has returned to Kingston, Ont., for a period of home leave. He expects to return to Ceylon in November.

T. D. Martin, P.ENG., formerly of Burlington, Ont., is now employed as mechanical engineer on the design and development of vending machines with Ideal Venders Ltd., Desoronto, Ont. This company is a subsidiary of Eddy Match.

Personals

News of the Personal Activities of Members of the Institute

J. Lefort, M.E.I.C., (B.Eng., McGill, 1936; B.C.L., McGill, 1938), has been appointed managing director of Warnock Hersey Management Consultants Ltd., at Montreal. Active in this field for many years, Mr. Lefort was in recent times associated with the Ford Motor Company of Canada Ltd., on special products in the office of the executive vice-president, and was manager of the dealer planning department at central staff.

Philip B. French, M.E.I.C., (B.Eng., mech., McGill, 1934), for many years a well-known figure in the anti-friction bearing field, has resigned from a vice-presidency of Lyman Tube & Bearings Limited to form his own Company. Mr. French has devoted his entire professional life to work in the bearing field. He will concentrate on the application and distribution of highly specialized precision bearings designed to meet today's complex needs.

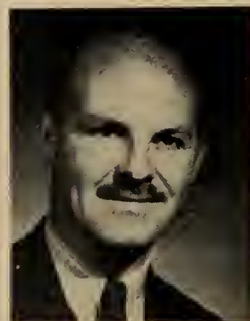
Incorporation arrangements for his new organization are now in hand for the opening of offices in Montreal and Toronto.

J. Morgan, M.E.I.C., (Loughborough, 1944), has been appointed a division engineer with the Foundation Company of Quebec Limited. Mr. Morgan joined Foundation in 1952, was transferred to Geocon Limited in 1954, and became chief engineer the following year. In 1957 he was named vice-president of that organization, and gained a directorship in 1958.

Ottis I. Logue, M.E.I.C., (B.Sc., civil, New Brunswick, 1946; M.Sc., civil, New Brunswick, 1954), 1957-1958 chairman of the Fredericton Branch of the E.I.C., is a consulting engineer with the Fredericton firm of Associated Designers and Inspectors.

Active in the affairs of the E.I.C., for some time, Mr. Logue was secretary of the Fredericton Branch, 1954 to 1956, and vice-chairman for the 1956-1957 term of office.

H. F. Morrow, M.E.I.C.



Philip B. French, M.E.I.C.

A. M. Stevens, M.E.I.C.

W. L. Hetherington, M.E.I.C., (B.A.Sc., elec., British Columbia, 1939), has, following the merger of the Ferranti Electric Limited and the Packard Electric Company Limited, been named to the executive post of vice-president and general manager, marketing division, Toronto.

Harold Francis Morrow, M.E.I.C., (B.Sc., geology, Sask, 1937; M.A., Queen's; Ph.D., McGill), a consulting geologist with Low and Morrow has transferred from the Western Canadian office at Regina to Victoria, B.C.

A. M. Stevens, M.E.I.C., (B.Sc., civil, New Brunswick, 1947; M.Sc., civil, New Brunswick, 1957), associate professor of civil engineering, University of New Brunswick has been awarded the Canadian Salt Good Roads Scholarship according to an announcement of the award of six scholarships to Canadian engineers by the Canadian Good Roads Association. Mr. Stevens is also a partner in the consulting engineering firm of Associated Designers and Inspectors.

H. C. Lawton, Affiliate, M.E.I.C., electrical contractor of Saint John, N.B., has announced that his business is henceforth a limited company to be known as H. C. Lawton (Electric) Ltd. Mr. Lawton, the president, has been connected with the electrical trade in Saint John for fifty years, having been apprenticed to the former Vaughan Electric Company in 1907.

Cdr. (E) V. F. O'Connor, R.C.N., M.E.I.C., (B.Sc., mech., Nova Scotia Technical College, 1934), principal naval overseer, Toronto area, was recently transferred to this post from Montreal where he was with the Naval Engineering Test Establishment.

B. Hardcastle, M.E.I.C., (B.Sc., civil, Edinburgh, 1945), has resigned from the post of division engineer with McColl Frontenac Oil Company Limited, Toronto, and has, of June 1, assumed the responsibility of manager of operations, Ontario division, with BP Canada Limited, Toronto. Mr. Hardcastle is secretary of the Joint Area Committee of the Toronto Branch, E.I.C.

D. A. Barnum, M.E.I.C., (B.S., civil, Michigan, 1928), manager of the transmission tower division, Provincial Engineering Ltd., Niagara Falls, Ont., is the chairman of the Niagara Peninsula

J. Lefort, M.E.I.C.

O. I. Logue, M.E.I.C.

D. A. Barnum, M.E.I.C.

Branch of the E.I.C. Mr. Barnum was associated with the Canadian Bridge Company from 1929 to 1953, at which time he accepted his present appointment.

Gordon T. Haig, M.E.I.C., (B.Sc., elec., Manitoba, 1929), of the Prairie Pipe Manfacturing Company Limited, Regina, Sask., has been promoted to assistant general manager of the firm. Earlier he was plant manager with the organization.

E. W. King, M.E.I.C., (B.Sc., elec., Alberta, 1943), has moved from Edmonton to Whitehorse, Y.T., in order to take over the general managership of the Yukon Electrical Company Limited, and the Yukon Hydro Company Limited. Mr. King was formerly transmission and distribution superintendent with Canadian Utilities Limited.

John G. Beresford, M.E.I.C., (B.Sc., Michigan, 1945), has been appointed manager of the Toronto apparatus factory, Linde Air Products Company, division of Union Carbide Canada Ltd. In his new capacity Mr. Beresford will be in charge of the manufacturing and warehousing of welding equipment and supplies.

W. F. Allen, M.E.I.C., (B.A., civil, Sciences Tripos, Cambridge, 1949; M.A., Cambridge, 1953), is carrying on his engineering career at Toronto with the firm of Sherwood Properties Limited. Formerly at Edmonton, Mr. Allen was chief engineer for A. C. Trowbridge and Associates Limited.

Percy C. Toft, M.E.I.C., (B.Sc., civil, New Brunswick, 1949), resident engineer with the Canadian General Electric Company Limited, civilian atomic power department, Peterborough, has accepted employment as project engineer with Humphreys and Glasgow of Canada Limited, Toronto.

J. S. Foster, M.E.I.C., (B.Eng., mech., N.S.T.C., 1943; B.Eng., elec., N.S.T.C., 1946), has moved from Peterborough, Ont., to Toronto. Mr. Foster is employed with Atomic Energy of Canada Limited, nuclear power plant division.

A. Klain, M.E.I.C., (diploma, Brunn, Czechoslovakia, 1946), formerly of Montreal, is now employed as a town planner with the Regional Planning Commission, Cleveland, Ohio. During the 1956-1957 term Mr. Klain followed a graduate level course in community planning at McGill University.

M. L. Zirul, M.E.I.C., (B.A.Sc., civil, British Columbia, 1941), has been appointed chief of operations division, water rights branch, Department of Lands and Forests, Government of British Columbia. Employed with the Province of British Columbia, water rights branch, since 1946, his former post was that of senior hydraulic engineer of the improvement district engineering section with the branch.

Donald L. Halsall, M.E.I.C., (B.Sc., elec., Queen's, 1949), has transferred his services from the Sylvania Electric Products Inc., Seneca Falls, New York, to the International Resistance Company Limited, Toronto. A supervisor of quality control in the former post, he will now carry out the duties of chief engineer.

Beno A. Eskenazi, M.E.I.C., (B.Sc., civil, Istanbul, Turkey, 1946; M.Eng., civil, McGill, 1949), consultant in structural engineering has opened a private practice in Montreal. Mr. Eskenazi was formerly chief engineer with the firm of Henry Jason, consulting engineer, Montreal. Mr. Eskenazi spent more than four years as a structural designer with T. Pringle and Sons, Montreal, at an earlier date.

David A. Foster, M.E.I.C., (B.Sc., mech., British Columbia, 1951), of Moncton, N.B., has been appointed Maritime district superintendent of motive power and car equipment for the Canadian National Railways. Since 1956 he has been engaged in the work of regional mechanical engineer.

F. R. Denham, M.E.I.C., (B.Sc., mech., Durham, England, 1950; Ph.D., Durham, 1953), a member of the executive of the Niagara Peninsula branch of the E.I.C., has been named assistant to the superintendent of the Electro Metallurgical Company, division of Union Carbide Canada Ltd., Fonthill, Ontario.

R. J. Pryor, M.E.I.C., (B.Eng., mech., Sheffield, 1945), formerly of Kelowna, B.C., and of Racey, McCallum & Associates, Ltd., Montreal, has moved to Alameda, Calif., with the Pacific Bridge Company.

Maurice Armstrong, M.E.I.C., (B.Sc., civil, Michigan, 1950), of Windsor, Ont., is the 1958 chairman of the Border Cities Branch of the Institute. Mr. Armstrong studied engineering following service in World War II. Later he became associated with C. G. Russell Armstrong in a consulting engineering practice on projects dealing with waterworks, municipal engineering, surveying land assembly development and other fields. At present he is a partner in the firm.

C. J. Karasek, M.E.I.C., (B.Sc., civil, London, 1953), project engineer with the construction branch of the Saskatchewan department of highways, has been awarded the Standard Gravel Good Roads Scholarship for postgraduate studies in the highways and highway transportation field.

Professor W. G. Heslop, M.E.I.C., (B.A. Sc., Toronto, 1930), of the University of British Columbia, department of civil engineering, was named chairman of the Vancouver Branch of the E.I.C., for the 1958-1959 term of office.

Guy L. Rainville, M.E.I.C., (elec., mech., B.A.Sc., Ecole Polytechnique, 1947) formerly resident engineer, roads department, Province of Quebec, has transferred his services to the traffic signals section, traffic department, City of Montreal, to work on the timing and co-ordinating of traffic signals.

J. M. Richardson, M.E.I.C., (B.Sc., elec., New Brunswick, 1941, has been appointed manager, marketing, with the Canadian General Electric Company Limited, motor and control department, Peterborough. For the past two years Mr. Richardson has been manager, sales and motor control department.

A. F. Brooks, M.E.I.C., (B.Sc., chem., McGill, 1950), has been appointed plant superintendent, nitrate and nitric acid plants, Warfield department, chemicals and fertilizers division, Consolidated Mining and Smelting Company of Canada Limited.

Thomas A. Bowles, M.E.I.C., (B.A.Sc., civil, Toronto, 1950), is construction manager of the firm of Bedford Construction, Toronto. He was formerly a district engineer with Geocon Limited, also at Toronto.

D. E. Rudolph, M.E.I.C., (B.Sc., elec., New Brunswick, 1952), will return to Canada

Percy C. Toft, M.E.I.C.

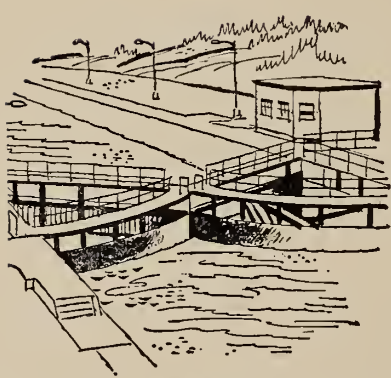
C. J. Karasek, M.E.I.C.

W. G. Heslop, M.E.I.C.

7 Major St Lawrence River Projects

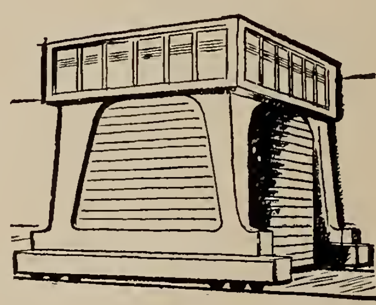
BY DOMINION BRIDGE

ONE engineering company . . . Dominion Bridge . . . is currently at work on several of the largest steel structures for the St. Lawrence Seaway and Power Developments. The diversity of this work—which includes design, manufacture and erection—is matched by the diversity of Dominion Bridge facilities. Seven of these major projects are described here. These, and others, will make an important contribution to the St. Lawrence River developments and to the economic advancement of Canada.



SIX PAIRS OF SECTOR GATES

have been built for the shipping canals. Each pair is 45 ft. high and weighs about 500 tons. Four pairs have been installed at Iroquois, Ont. and will act as the operating gates of the lock. There is also one pair of guard gates for each of the Beauharnois and Cote Ste. Catherine canal reaches in Quebec.

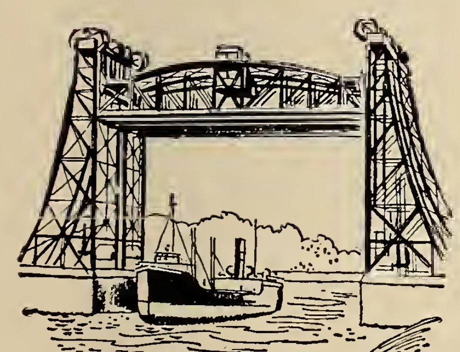


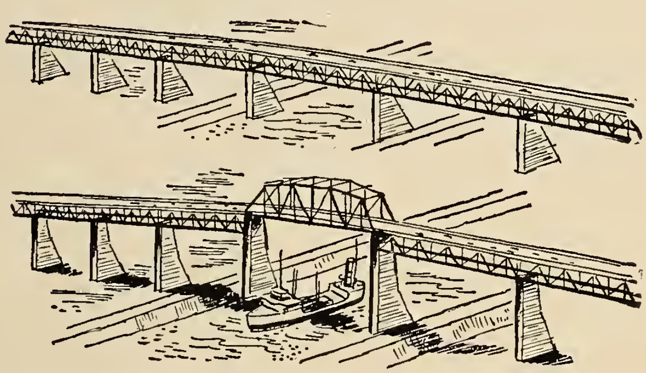
HUGE CRANE ACTS AS "TRAVELLING POWER HOUSE"

A 300-ton gantry crane, the largest ever built in Canada, was designed and fabricated for the Canadian half of the Barnhart Island Power House. Completely enclosed, the crane illustrates a modern trend in design and serves, in effect, as a "travelling power house."

48 GATES FOR BARNHART ISLAND POWER PROJECT

These hydraulic head gates comprise the largest order of its kind ever placed in Canada and were fabricated for Ontario Hydro. They are designed for openings 17 ft. wide by 37 ft. high. Each will withstand a pressure of 3,000,000 lbs. under a 93 ft. head of water.





• PERSONALS

shortly from Taplow, near Maidenhead, Berks, England, following a year spent in England on a scholarship provided by Phillips Electrical Company of Brockville, and British Insulated Callendar's Cables. Mr. Rudolph was employed with the Maritime Telegraph and Telephone Company before winning the scholarship.

J. H. Douglas, M.E.I.C.

J. H. Douglas, M.E.I.C., (B.Eng., mech., McGill, 1946), was some months ago elected chairman of the Sarnia Branch of the Engineering Institute. Professionally Mr. Douglas is associated with Dow Chemical of Canada Limited, Sarnia.

H. F. Pragnell, JR.E.I.C., (Royal Military College, 1942; B.Eng., civil, McGill, 1949), has been appointed office engineer with Henry Kaiser Company (Canada) Ltd., Montreal. He was formerly associated with the Foundation Company of Canada and the Eddy Match Company on various engineering projects. Mr. Pragnell was a member of the committee to organize the Chalk River Branch of the Institute.

Major S. M. Bancroft, JR.E.I.C., (B.Eng., civil, N.S.T.C., 1949), has left the Canadian Army Staff College, Kingston. Major Bancroft has been transferred to the directorate of design and development, Army Headquarters, Ottawa.

Robert William McBain, JR.E.I.C., (B.M.E., Detroit, 1954, has taken over the post of sales engineer with the American Standard Products (Canada) Ltd., at Windsor.

CORRECTION:
Squadron Leader Paul F. McNichol, JR.E.I.C., (B.Eng., Nova Scotia Technical College, 1950), of the construction engineering branch, A.M.C., Ottawa, was recently promoted to this rank. The Journal regrets that an error was made in naming the promotion in the August issue of the Journal.

Captain R. L. Hamel, JR.E.I.C., (B.A.Sc., mech., elec., Ecole Polytechnique, 1953), now serves as officer in command of the inspection and servicing at 4 Coy. R.C.E.M.E., Montreal. Captain Hamel has returned to Montreal from the Middle East where he was officer in

To Promote SAFE Handling of Explosives

Where blasting operations are involved, safety begins with on-the-job instruction. To protect the men who handle explosives and to keep them well-informed in their "do's" and "don'ts" Du Pont of Canada has placed a safety folder in every case of Du Pont Explosives. This helpful folder, "Prevention of Accidents in the use of Explosives", is bilingual and easily readable. Quantities are available for your own safety program.

Contact your Du Pont representative or mail this coupon:

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• PERSONALS

command of the vehicle section, 56 Canadian Infantry Workshop, R.C.E M.E., United Nations Emergency Force, Egypt. He also carried out the duties of Military Observer with the U.N.T.S.O., the Israeli Syrian Mixed Armistice Commission, Tiberias, Israel.

K. H. Cram, JR.E.I.C., (B.Eng., chem., McGill, 1947), has left Montreal, where he held the post of assistant professor of chemical engineer, at McGill University, in order to accept an appointment with E I. dePont de Nemours and Company.

J. H. Goar, JR.E.I.C., (B.Sc., elec., Man., 1948), formerly manager of the Hamilton Branch, Canadian Westinghouse Company Limited, has been appointed sales manager for the company's power transformer division in that city.

John H. Flett, JR.E.I.C., (B.Eng., civil, McGill, 1949), assistant engineer for the Canadian Pacific Railway for the past two years at Saint John, N.B., has been named roadmaster of the railway at North Devon, N.B.

N. D. Heaslip, JR.E.I.C., (B.A.Sc., chem., British Columbia, 1951), formerly of the West coast, with Canadian Industries Limited, Victoria, has been transferred to Montreal. He is with the explosives division, production department of C.I.L. in his new location.

T. B. Lounsbury, JR.E.I.C., (B.Eng., elec., McGill, 1950), has been appointed manager of the Canadian Westinghouse lamp division, Trois Rivieres, Que., Mr. Lounsbury has been manager of the meter and relay division of the company at Burlington, Ont.

C. Cameron Johnson, JR.E.I.C., (B.Sc., civil, New Brunswick, 1950), has been transferred from Fort Smith, N.W.T., to head office, Ottawa, with the Department of Northern Affairs and National Resources. He is with the northern administration and lands branch, works, research and planning division.

H. Maissonneuve, JR.E.I.C., (B.A.Sc., mech., elec., Ecole Polytechnique, Montreal, 1952), formerly with the Northern Electric Company, Montreal, has transferred his service to the Montreal Engineering Company Limited, Montreal.

Paul R. Bennett, JR.E.I.C., (B.Sc., mech., Queen's, 1956), has since June 1, been employed with the Spruce Falls Power and Paper Company Limited, as an instrument engineer in the Spruce Falls and Kimberley-Clark of Canada mills, Kapuskasing, Ontario.

W. Laskaris, JR.E.I.C., (B.Sc., civil, Queen's, 1952), who joined the Department of Public Works of Canada, high-

What Carl should know

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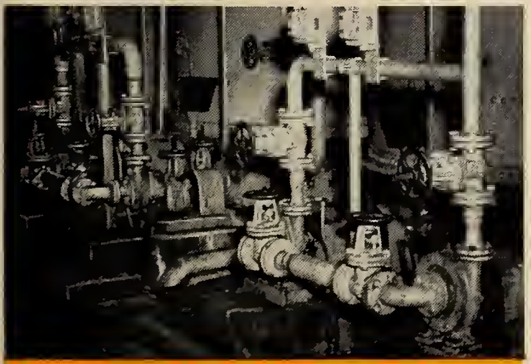
Jenkins All-Iron Gate Valves controlling the supply of caustic soda in the manufacture of Viscose in the churn room of Courtaulds (Canada) Ltd., Cornwall, Ont.



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way division, early in 1958, is engaged in the work of highway engineer at Banff, Alta., Mr. Laskaris is involved in an extensive highway construction program in the National Parks in Western Canada and in particular the Banff district, including Jasper, Yoho, Kootenay, Glacier and Revelstoke National Parks.

J. O. Down, JR.E.I.C., (elec., Poplar Technical College, London, 1953), recently at Asbestos, Que., with Canadian Johns Manville Company Limited, is now employed with the Canadian British Aluminum Company as an electrical maintenance engineer.

H. J. Bredin, JR.E.I.C., (B.Sc., civil, Alberta, 1950), has relinquished the post of Town Engineer at Flin Flon, Man., in order to accept responsibility as Town Engineer for Jasper Place, Alta.

Frank E. Barrett, JR.E.I.C., (B.Eng., elec., McGill, 1950), has been elected president of the Lions Club of Montreal. Mr. Barrett is chief engineer of the Thomson Electric Works Ltd.

David Hay, JR.E.I.C., (B.A.Sc., mech., British Columbia, 1956), has left the employment of H. A. Simons Ltd., Vancouver, and has accepted a post with MacMillan and Bloedel Ltd., in their Western district engineering department at Port Alberni, B.C.

F. E. Barrett, JR.E.I.C.

John Martin, JR.E.I.C.

J. Ross, S.E.I.C.

John Martin, JR.E.I.C., (B.Sc., mech., Sask., 1957), has completed a course in business administration at the University of Saskatchewan, where he received a diploma. He has accepted training as a sales engineer in the air-conditioning department of the Canadian Ice Machine Company Limited at Winnipeg.

J. D. Norman, JR.E.I.C., who a number of months ago left his work as contracts engineer, with the St. Lawrence Power Project, New Town, No. 1, Ontario Hydro-Electric Commission, is with the M. M. Dillon and Company Limited, London, Ont. in the municipal engineering section of that organization.

Colin C. Nicholson, JR.E.I.C., formerly of the Canadian General Electric Company Limited, Toronto, has for a number of months been employed with the Canadian Westinghouse Company Limited, electronics division, at Hamilton, Ont.

Gilles Rousseau, S.E.I.C., (B.Sc., civil, Ecole Polytechnique, 1957), is an engineer trainee with Perini Quebec Inc., general contractors. In 1957 employed on the Chutes des Passes Power Development, he was recently transferred to the Bersimis No. 2 Development.

Wayne E. Randall, S.E.I.C., (B.Eng., civil, Saskatchewan, 1958), has begun his professional career as a project engineer with the Department of Agriculture, conservation and development branch, Swift Current, Sask.

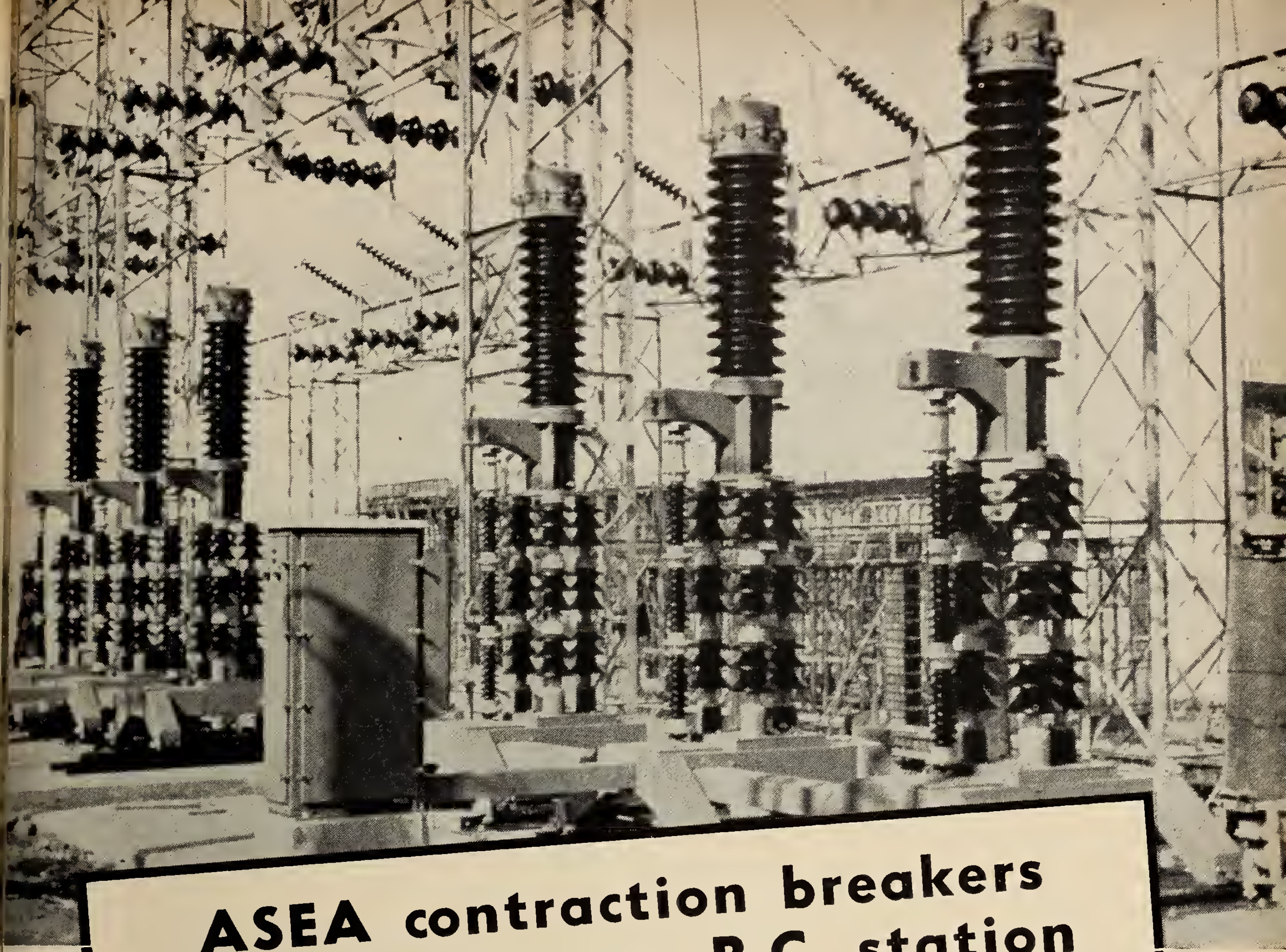
Flying Officer Emil Bizon, S.E.I.C., (B.Eng,. elec., McGill, 1958), has begun his graduate engineering career with service in the telecommunications branch of the Air Material Command Headquarters, Rockcliffe, Ont.

Stephen V. Allison, S.E.I.C., (B.Eng., civil, McGill, 1958), has embarked on his graduate career in engineering in the services of the Canada Green Construction Company, Calgary.

Donald Murray Watt, S.E.I.C., (B.Eng., mech., Nova Scotia Technical College, 1958), is working as an engineer trainee with the B.A. Oil Company Limited, Montreal East refinery.

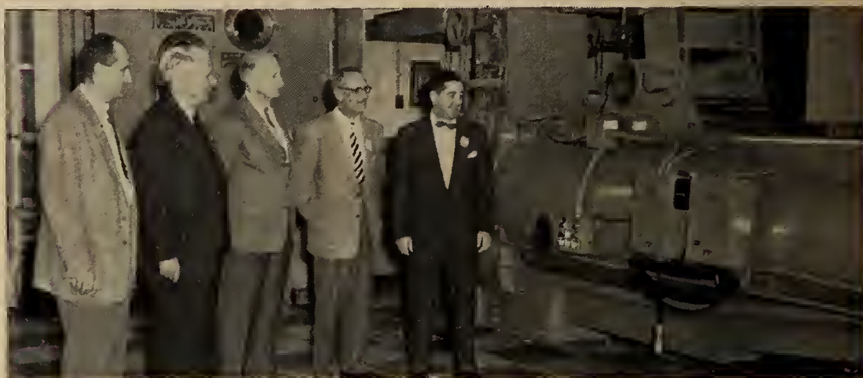
W. J. Ross, S.E.I.C., (B.Sc., civil, New Brunswick, 1958), has been awarded the Union Tractor Good Roads Scholarship for post-graduate studies in the highway and transportation field.

F/O Thomas Jeary, S.E.I.C., (B.Eng., mech., Nova Scotia Technical College, 1958), has recently been stationed at the R.C.A.F. station, Portage, Man., where he was engaged in flying T-33 aircraft.



NEWS OF THE BRANCHES

Activities of the Fifty Branches of the Institute and abstracts of the papers presented at their meetings



During the visit of President Anson and Dr. L. Austin Wright to the Chalk River Branch for its inauguration the N.R.U. reactor building was inspected. The photo shows the shielded flask and storage block for handling radioactive material from the N.R.U. reactor. Left to right are: C. A. Crawford, Branch chairman, Dr. D. A. Keys, Dr. L. A. Wright, Dr. Anson, and J. L. Gray, president of Atomic Energy of Canada Limited.

CHALK RIVER

W. O. Findlay, M.E.I.C., *Secretary*

C. A. Crawford, JR.E.I.C., *Branch News Reporter*

The recent inauguration of the Chalk River Branch of the Institute was the occasion for a visit by President Anson and Mrs. Anson, Dr. L. Austin Wright, then general secretary, E.I.C., and Mrs. Wright. Also present were Hector Chaput and W. V. Morris, chairman and secretary of the Ottawa Branch, which provided a substantial cheque as an aid to the new group in its first endeavors.

The provisional chairman for the evening, C. A. Crawford, was elected Branch chairman and appointed a councillor to attend the annual meeting of Council held in Quebec City a short time later. Also elected to office were J. G. Melvin, C. E. L. Hunt, J. S. Flavell, and secretary W. O. Findlay.

Lorne Gray, M.E.I.C., newly elected president of Atomic Energy of Canada Limited was a head table guest.

President Anson was the official speaker for the evening and later the meeting was turned over to questions and observations from the floor.

VANCOUVER ISLAND

J. A. Cowlin, JR.E.I.C., *Sec.-Treas.*

H. F. Coupe, M.E.I.C., *Branch News Reporter*

Engineering Training in Victoria was advised by Dr. L. Austin Wright, immediate past general secretary of the E.I.C., in a recent visit to that city. Dr. Wright's recommendation that the first two years of the four-year engineering course to be completed at the University of British Columbia, Vancouver, should be given at Victoria College has been followed up by a preliminary study on the part of J. B. Nuttall, JR.E.I.C., into the possibility of establishing such a course. Mr. Nuttall's report submitted to Grant Griffiths, Branch chairman, states that considerable precedent exists in this field. The Nova Scotia Technical College provides the final two years of study to students from four colleges in the province. Mount Allison University, N.B., the University of Sherbrooke, Que., and the University of Alberta, Calgary division, provide similar facilities to those envisaged for Victoria College, and serve comparable populations. Feasability of the course depends on the number of students to be served, quality of training, as well as the place which such an endeavor would occupy in the overall scheme of higher education in British Columbia.

An estimate of the size of the prospective student body reveals that if training were begun in 1959 as estimated 50 students would seek admission. The number would increase to 70 by 1962. Annual cost to maintain students regis-

On the occasion of the Ottawa Branch field trip to the St. Lawrence Seaway, Cornwall section, on May 31, 1958. Long Sault Dam is seen in the background. *(See page 142 for report)*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tered in both first and second year courses has been estimated at $38,000, $21,000 to be made up from government and private sources. Direct cost to the province would be 10 per cent higher than the same training given at Vancouver. Annual cost to a student in the Victoria area would be $400.00 less.

The majority of professional engineers in the area were enthusiastic about the establishment of an engineering course for the College. Opinion was however unanimous that training at the University would be better than at Victoria College if the cost to the student was no object.

Mr. Nuttall's study concluded that while changes in methods of technological education may in another decade make engineering training in Victoria impractical, it is now in the public interest. Copies of the study circulated to Branch members created a response which was overwhelmingly in favour of directing the Branch executive to take a public stand favouring the measure. As an initial stand it is planned to pass the report of the preliminary study to the appropriate committee of the Victoria Chamber of Commerce, which has been active in the matter in the past.

Naval Tour

The United States aircraft carrier Bennington was the object of a Branch tour on July 11. The Bennington, along with several smaller ships of the U.S. Navy and the cruiser Newcastle, of the Royal Navy, were a part of the naval review of 32 warships held July 15 in honour of the B.C. Centennial and the visit of Princess Margaret.

A 40,000 ton cruiser with a length of 889 feet and an extreme width of 206 feet, the Bennington was commissioned originally in 1944, saw service at Okinawa and in bombing raids on Tokyo. Completely modernized since then, it includes the addition of an angle landing deck to enable aircraft to land and take off simultaneously. Three squadrons of jet fighters, two helicopters, and aircraft for heavy bombardment and high altitude photography are carried, totalling eighty aircraft, some of which were on display for close inspection by the engineers. The ship's engines develop 150,000 h.p., using four screws to attain a maximum speed of thirty knots. A complement of 2800 officers and men are required to man the ship, including representatives of thirty professions and trades.

OTTAWA

W. V. Morris, M.E.I.C., *Secretary*

A. H. Graves, S.E.I.C., *Branch News Reporter*

Rockets and satellites were under discussion at the May 1 meeting of the Ottawa Branch, E.I.C., held jointly with


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• BRANCH NEWS

the American Institute of Electrical Engineers and the Canadian Institute of Mining and Metallurgy, Ottawa branch. Gordon D. Watson, director of weapons research, Defence Board, is responsible for the co-ordination and planning of the Canadian research program in the weapons field. His talk, "Rockets, Earth Satellites and Space Travel," was mentioned in the July issue of the Journal, Branch News section, page 112. It is summarized on page 146 of this issue.

JOHN P. STERLING, M.E.I.C., chief engineer Defence Construction 1951 Ltd., Ottawa, at a May 15 meeting of the Ottawa Branch E.I.C., gave a talk heard by seventy-five members, on "The Columbo Plan — Canadian Engineers Look Eastward." Mentioned briefly in the July Journal, page 112, it is here dealt with in greater detail.

Mr. Sterling said that Canadian engineers working on eleven Columbo Plan projects in the Far East are making a valuable contribution to the development of a free world. Canadians helping to create these $188 million worth of power plants, and other schemes in India and Pakistan are producing results far beyond their technical and material aspects. The Department of Trade and Commerce, International Economic and Technical division directs Canadian aid to these countries. Defence Construction Limited is the technical advisor and administrative agency for engineering and for construction products.

Largest major project under way with Canadian aid is Warsack in West Pakistan, a combined hydro-electric and irrigation project, slightly smaller than the Des Joachims plant on the Ottawa River. Mr. Sterling presented coloured slides to outline the project. It will replace thermal power with 220,000 horsepower of electricity. One hundred and twenty-five thousand acres of land will be irrigated and opened up for settlement.

Canadian engineers and contractors are working on jobs at Shadiwal hydro-plant in West Pakistan; Ganges Kobadak thermal power plant in East Pakistan, Kundah hydro-power project in South India, the Maple Leaf cement plant at Daud Khee in West Pakistan and a fish refrigeration and by-product plant in Columbo, Ceylon.

Other Canadian Columbo Plan projects include Umtru, a small hydro-electric plant in Assam, India; Canada Dam and Mayurakshi Reservoir, in India; the Goalpara steam generating station in East Pakistan and two power transmission line projects, one of 70 miles in Ceylon, and one in East Pakistan of 150 miles.

Mr. Sterling was introduced by branch chairman Hector Chaput and was thanked by treasurer Hugh Brown.

A SEAWAY TOUR was enjoyed by the Ottawa Branch for its May 31st meeting.

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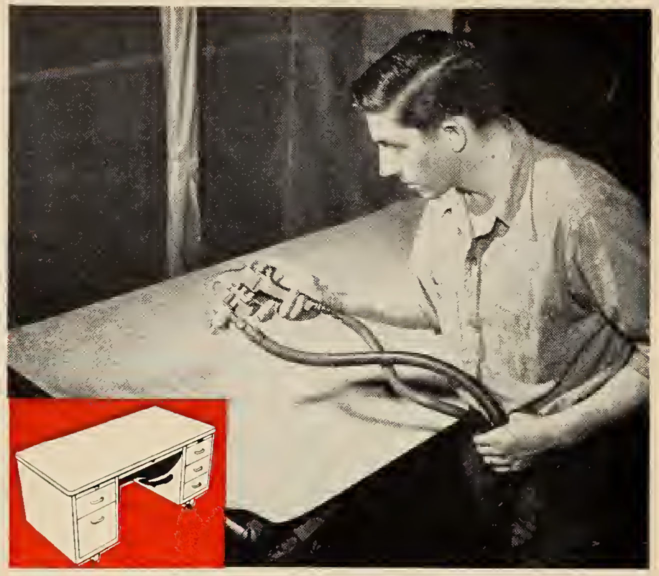

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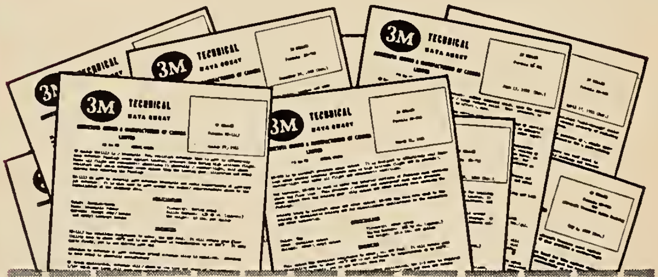

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● BRANCH NEWS

Seventy persons travelled by bus to New Iroquois, to join a guide from the Ontario Hydro-Electric Commission. Following a tour of the Iroquois Lock, control dam, and the new townsite, a ten-minute film covering the overall project was shown. A second tour which included the powerhouse, headworks, and other points of interest in the Cornwall section concluded the day's events.
For picture turn to page 138.

A DINNER MEETING was held on May 26 by the Ottawa Branch, E.I.C., in honour of the I.E.E. and the general secretary of the latter organization, Mr. K. Bracher, of London England.

APPLICATION FOR MEMBERSHIP in the E.I.C. has been received from Robert Owen King by the Ottawa Branch. Mr. King graduated in engineering from McGill University in 1895; and received a master's degree from that institution in 1898. He is presently employed with the Defence Research Board, Department of National Defence and is in his eighty-fourth year.

AN ANNUAL EVENT of great interest to engineers of Ontario and Quebec, the fourth Ottawa Valley Engineers Annual Golf Tournament was held June 13, 1958 at the Arnprior Golf Club, at Arnprior, Ont.

Engineer members of six engineering groups were invited to participate and combined to produce a total enrolment of one hundred and fifty persons for the event. Taking part in the tournament were: The American Institute of Electrical Engineers; the Association of Professional Engineers of Ontario; The Canadian Institute of Mining and Metallurgy; The Chemical Institute of Canada; the Corporation of Professional Engineers of Quebec, and The Engineering Institute of Canada.

Sponsor for 1958, the Corporation of Professional Engineers of Quebec, presented The Quebec Corporation Trophy to the individual player having the lowest gross. This was M. Ross whose score was 76. For the first low gross Mr. Ross was also awarded a portable radio. Seventeen other prizes were awarded.

Review of Talk on Rockets, Earth Satellites and Space Travel

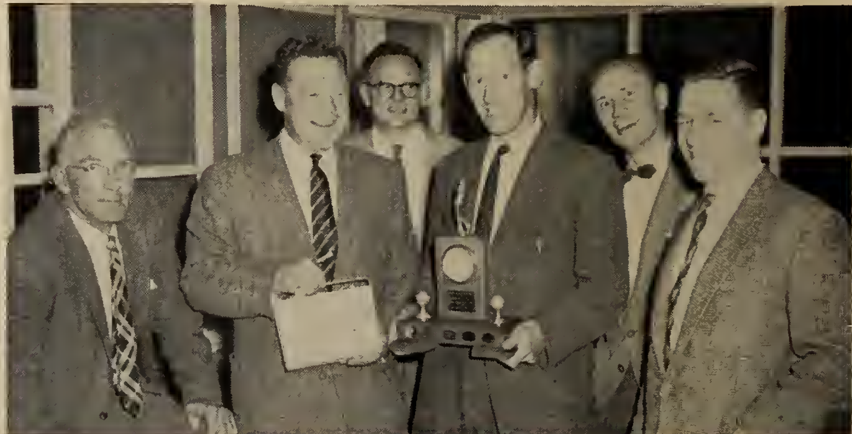
Mr. Watson reviewed the history of rocketry and dealt with the scientific data only recently obtained from orbiting earth satellites. He outlined the known problems relative to space travel and discussed current approaches to their solution.

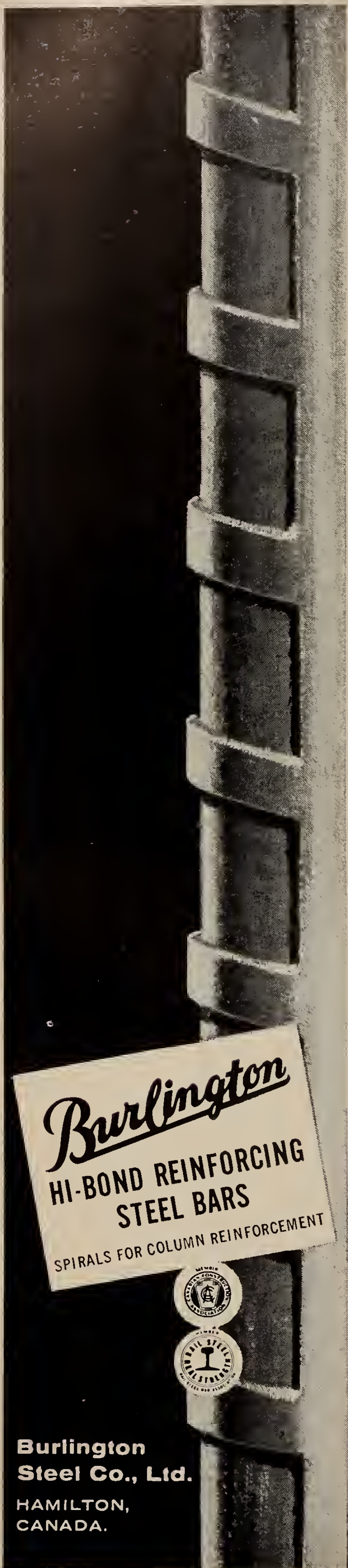
Fuel Systems

Chemical fuel systems are reaching the limit of their capability. Although some improvement is possible, it is unlikely that specific impulse can be raised more than a few percent. Nuclear reactions offered the best possibility for obtaining high energy per unit weight of fuel. The combination nuclear-chemical engines in which a nuclear reactor is used to heat liquid hydrogen might prove to be the earliest practical rocket engines with major improvements. Controlled fusion reactions might also be used to heat liquid hydrogen, but practical fusion reactors are probably further away than the fission reactor already operative for fixed power plant use. The limitation of chemical rockets, the velocity with which the gas molecules can be ejected at temperatures than can be contained in the rocket, has led to examination of the possibility of accelerating nuclear particles, ions and photons, and using the reaction of these particles for thrust. The ion rocket has been the subject of current research and a U.S. scientist recently expressed the opinion that it is likely to be the first practical power-plant using charged particles.

These motors are not yet practical however, because of the excessive weight

At the Fourth Ottawa Valley Engineers Annual golf tournament on June 13, at Arnprior, Ont. Shown left to right are Fred Wrangell, representing Arthur Bidden, C.P.E.Q. regional representative; Blake Goodings, field representative, A.P.E.O.; Rudy Meyer, golf committee chairman, C.P.E.Q.; M. Ross, who was awarded the Quebec Corporation Trophy for the first low gross; Hector Chaput, chairman, Ottawa Branch, E.I.C., and Pierre Bournival, general secretary, C.P.E.Q.





• BRANCH NEWS

of the machinery required to convert nuclear to electrical energy. U.S. scientists have pointed out that before particle rockets can be practical, a more direct conversion from nuclear to electrical energy is needed.

Ballistic Rockets and Satellites

Mr. Watson discussed ballistic rockets as forerunners of satellites and outlined at some length the scientific laws governing the trajectories both of ballistic rockets and satellites. The job of establishing an earth satellite is not easy. The force of gravity demands the expenditure of a considerable amount of energy to lift the satellite; the earth's atmosphere demands that any satellite which is to have a reasonable life span must be launched at about 5 miles per second above the majority of the atmosphere at an altitude of 150 or 200 miles. Multiple stage rockets are particularly important in satellite launching, as fuel tanks and unwanted structure can be discarded when their purpose has been served.

I.G.Y. Satellite Projects

A number of interesting facts which have resulted from the International Geophysical Year Satellite projects were enumerated.

Sputnik I with the lowest orbit, and Sputnik II have both already re-entered the atmosphere and either burned up or impacted. The U. S. Explorer and Vanguard satellites, both lighter than their U.S.S.R. counterparts, were moving in higher level orbits and could therefore expect longer lives.

The rate at which satellites are slowed up depends on the density of the atmosphere. The satellite program indicates that the atmospheric density at 150 to 200 miles altitude may be several (figures from 9 to 14 times have been quoted) times higher than had been estimated previously.

The temperature measurements obtained from Explorer I have recently been published and indicate that the methods used to control the internal temperature of the satellite have been successful in keeping the temperature between 97° and 120°F. These are quite reasonable limits for human endurance. The satellite's skin temperature lies between 63° and 143°F.

The Moon and Other Planets

Mr. Watson forecast that the next phase in space experimentation would be exploration of the moon employing techniques similar to those used for launching earth satellites. Possibilities are: impact on the moon, orbit and return to earth, and orbit an instrumented satellite around the moon. Eventually these instrument carriers might be landed on the moon and remotely controlled to explore and send back information. The velocity of a moon-rocket would have to be accurate to about 100 ft./sec. in 36,000 and the angle of launch should be within about 0.2 degrees.

(Continued on page 212)

Fifth Annual

Professional Engineers Ball

of

The Niagara Group of Professional Engineers
&
The Engineering Institute of Canada
Niagara Peninsula Branch

Friday, September 26, 1958

Prudhomme's Garden Center Hotel, Niagara Falls

Tickets: $10.00 per couple — **Dinner: 7.00 p.m.**

Cocktails: 6.00 p.m. — **Dress optional**

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CANADIAN CONSTRUCTION ASSOCIATION

News of Other Societies

CEA Meets at Banff

The 68th annual meeting of the Canadian Electrical Association was held at the Banff Springs Hotel, Banff, Alberta, June 30-July 2, 1958, with over 600 delegates in attendance.

V. A. Ainsworth, general manager, Newfoundland Light and Power Co., was elected president for the coming year. In his annual report, managing director, B. C. Fairchild noted membership had increased from 754 members in 1943 to over 1,600 this year.

CEA President, J. C. Dale told delegates that net generating capability at the end of 1957 for Canada's electric utilities was some 16,469 megawatts, up 9.9% over 1956. Forecast over the next four years is for an increase of 42.6%, with capacity in 1961 of 23,484 megawatts. Firm peak load in 1957 was 14,925 megawatts, up 7.2% over 1956, compared with the 11% increase in the previous year.

Margin of reserve capacity is beginning to widen sooner than expected. If the trend continues it will result in further and additional postponement of capital outlays for new plant, he observed. While current forecasts now predict for 1961 what was previously forecast for 1960, there was no need to be unduly pessimistic. Overall long-term growth would almost certainly not fall below 7%.

Nuclear power would not be a serious competitor on this continent in the electrical generation field for some time to come, he said. Actual costs of construction are running around $1,060/1,120 per KW, with power costs of 64 mills or 9 times that produced in a conventional plant. But the electrical industry could not afford to ignore the competition offered by the natural gas industry. In water heating, cooking, air conditioning, etc. natural gas was going to offer its greatest challenge.

From all reports, he remarked, the Canadian Electrical Manufacturer was facing serious competition from imports. While competition was generally conceded to be in the best interest of the consumer in the long run, advantages obtained by lowering standards and reducing safety factors were not . . . in the long run it was in the best interests of Canada to have a strong versatile electrical manufacturing industry.

President A. E. (Dal) Graver of the British Columbia Electric Co. Ltd. predicted deliveries of electricity were likely to go on doubling every ten to twelve years during the 'sixties' and 'seventies'. Electricity would probably continue to gain relative to other forms of energy. About 20 per cent of all the fuel and power used in Canada now took this form. Twenty-five years from now the proportion might increase to 30 per cent. Main effect of atomic energy would be to set a ceiling on the cost of electricity.

In a strong appeal for switching 15% of our imports from the U.S. to Canadian manufacturing rather than from the U.S. to U.K., Stuart Armour, economic adviser, The Steel Company of Canada, pointed out manufacturing had contributed $12 billion more to our national income in the past decade than had farming, fishing, forestry, mining and construction combined. If we even doubled our exports of primary products we should not progress without a corresponding growth in Canadian Manufacturing. Such growth, he emphasized would not be brought about by the encouragement of exports.

Speaking for the electrical manufacturing industry, H. B. Style, pointed to the problem it faced due to extreme variatons in demand for its products during the past 10 years. The industry's output had about doubled between 1947 and 1957. But orders for large transformers and generators from utilities from 1952 to 1954 averaged less than half those placed in 1951, while in the period 1952-1954 they had averaged over 2½ times the orders placed in the previous three years. Surely, he observed, there was some way to the advantage of both utilities and manufacturers of evening out these extreme swings.

It was inconceivable, he declared, that with the growing importance of thermal power in Canada we continue to place ourselves 100% in the hands of foreign suppliers for such basic prime movers as steam turbo-alternators. Where would we be in case of war or other major disturbances?

Addressing delegates on the application of Calder Type Atomic Stations to North American conditions Dr. H. S. Arms, M.E.I.C., of English Electric Co. of Canada, Ltd., estimated that a large Calder Type reactor might cost as much as 55 per cent more to build in Canada than in the U.K. on the basis of 120 per KW net sent out for Hinkley Point, this would give a cost of $480 per KW net sent out for Canada. No particular reasons could be seen for expecting operating costs significantly different from those for a conventional thermal plant in Canada, nor to suppose fuel costs in Canada would exceed those in the U.K. except for relatively small costs of freight and insurance.

IIW Conference Held at Vienna

The annual assembly of the International Institute of Welding, held June 29 to July 5, at Vienna drew the interest and attention of more than 800 persons from twenty-four countries. The event co-incided with the tenth anniversary of the foundation of the I.I.W. The opening session of the Assembly at the Vienna town hall was addressed by a number of eminent Austrians. Among them were the president of the Austrian republic, Dr. Adolf Scharf, the minister of trade and commerce and construction, Dr. Fritz Book, and Mr. Franz Jonas, mayor of Vienna.

The public session, following upon the opening session, was presided over by Professor Franz Rapatz, vice-president, I.I.W. and chief of the Austrian delegation, on the governing council of the organization. Authors of the thirty-one papers from fifteen different countries dealt with the various aspects of the principal theme, "Welding in the Chemical Industry."

Reports to be drafted by the chairmen of commissions will contain details of the principal business carried out at the Vienna meetings. These reports will be available during the year for publication in the world's technical press.

Thirty working documents were released with a view to their publication in specialized technical reviews.

A handbook on radiographic apparatus and techniques will be published under the auspices of the Institute.

Also marking the ten-year anniversary, the I.I.W. made a general report of work to date in a bilingual illustrated book of two hundred and fifty pages, published by the Belgian delegation. Yet


CF 105

another work publicised welding in Roumania.

Certain amendments were made to the constitution of the I.I.W.

There was close collaboration between the I.I.W. and the International Organization for Standardization, the governing council having approved the transmission to I.S.O. of a certain number of reports prepared by the commissions. Various questions raised by the I.S.O. will be investigated.

Arrangements were made to carry out a more detailed study of certain subjects, such as metalization problems and the welding of non-ferrous metals. Work will also start on new subjects such as the inspection of welded assemblies in plastics.

Two excursions, to the south and to the west of Austria, enabled members to visit the principal industrial centres of that country.

The 1959 Assembly will be held at Opatija, Yugoslavia, from June 28 to July 4. The public session will deal with welding and allied processes, gas cutting, building-up, bronze welding, surface hardening, metal-spraying in maintenance and repair work.

Calendar

Canadian Chamber of Commerce

Annual Meeting. Queen Elizabeth Hotel, Montreal, October 6-8.

National Association of Corrosion Engineers

Northeast Region Meeting. Boston, Mass., October 6-8.

American Society of Mechanical Engineers

Fuels — A.I.M.E. Conference. Old Point Comfort, Va. October 9-10.

American Gas Association

Annual Convention. Atlantic City, N.J., October 13-15.

A.S.M.E.–A.S.L.E.

Lubrication Conference. Hotel Statler, Los Angeles, Calif. October 14-16.

Second Energy Resources Conference

National Resources Council. Denver Chamber of Commerce. Brown Palace Hotel, Denver, Colo. October 15-17.

American Society for Metals

National Metal Exposition and Congress. Cleveland Public Auditorium, Cleveland, Ohio, October 27-31.

Steel Founders Society of America

13th Technical and Operating Conference. Carter Hotel, Cleveland, Ohio. November 10-12.

American Petroleum Institute

38th Annual Meeting. Conrad Hilton, Palmer House, and Congress Hotels, Chicago, Ill. November 10-13.

American Society of Mechanical Engineers

Annual Meeting. Hotels Statler and Sheraton-McAlpin, New York. November 30–December 5.

American Society of Refrigerating Engineers

45th Semi-annual Meeting. Hotel Roosevelt, New Orleans, La. December 1-3.

Industrial Engineering Conference

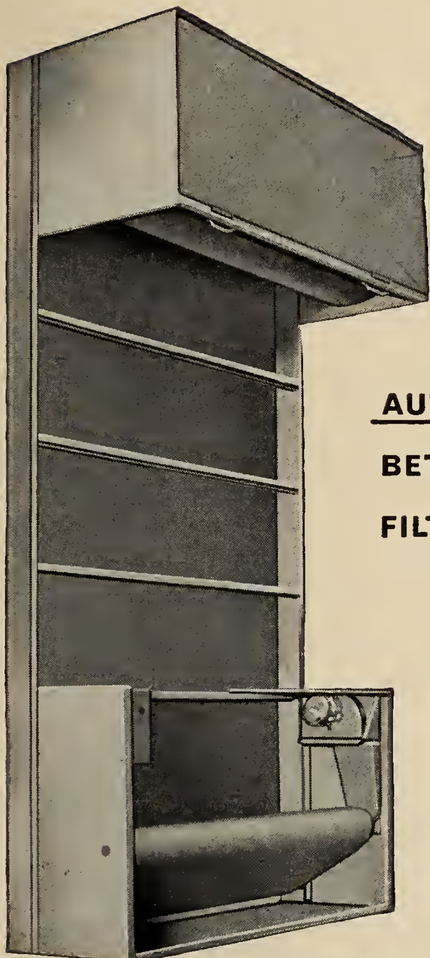
Illinois Institute of Technology, Chicago, Ill. December 4-5.

Chemical Institute of Canada

Regional Conference of Organic Chemistry Subject Division. University of Ottawa, Ottawa, Ont., Dec. 8-9.

Division of Industrial and Engineering

Chemistry, A.C.S. Christmas Symposium. Dec. 29-30.



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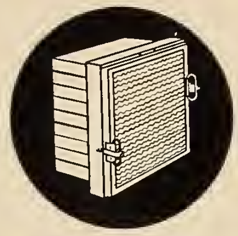

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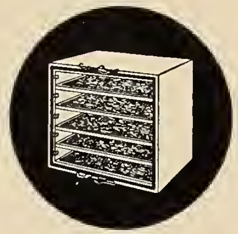
AFTER-FILTER
Bulletin B-1300-2



MICROLOC
Renewable media filter.
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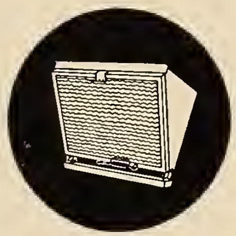
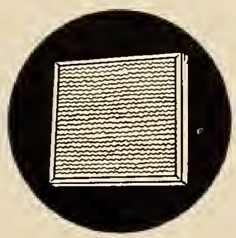


GREASE
ELIMINATOR
Bulletin B-201-5



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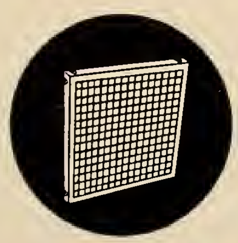
Bulletin B-1000-3



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BOOK NOTES

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*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

*AIRPLANE DESIGN MANUAL

A guide to the practical aspects of airplane design. Information is provided on the principles of aerodynamics, structural design, installation requirements, and the application of materials. In addition there is data on the economics of design, performance calculations, and allied problems. In this revised edition greater emphasis is placed on the analytical approach to design problems. (F. K. Teichmann. Toronto, Pitman, 1958. 489p., $8.50.)

*AN INTRODUCTION TO AUTOMATIC COMPUTERS

Intended to convey the computer's functions from a business systems point of view, with its uses and limitations. A discussion of major analysis techniques is included, with reference to applications, programming and operation. Many specific examples are included for purposes of illustration. Appendices provide extremely detailed data on automatic computers commercially available, including information on the arithmetic and logic unit, the storage unit, and input-output equipment. (N. Chapin. Toronto, Van Nostrand, 1957. 525p., $10.25.)

DAS LUSTIGE ATOM

This is a book of humorous verse, dealing with man's quest for knowledge, from Adam and Eve to the modern scientist and his atom bomb. Man's theories on the composition of matter from historical times to the present day atomic theory are included. The book goes on to talk about chain reactions, nuclear physics, uranium, and the explosion of the first atomic bomb, and concludes with what the future of the atom may have in store for mankind. Profusely illustrated throughout, it is amusing and entertaining reading. (Fritz Wolf. Essen, Vulcan-Verlag Dr. W. Classen. 192p., 9.60 DM.)

*MAN, METALS AND MODERN MAGIC

A history of the role that metals have played in the development of civilization. Beginning in 6000 B.C. and continuing to the present, the author traces the use of bronze and iron, the development of alloys, the expansion of metallurgy, and the metallurgy of nuclear fission. (J. G. Parr. Cleveland, American Society for Metals and Iowa State College Press, 1958. 238p., $2.95.)

MESURE ET DETECTION DES RAYONNMENTS NUCLEAIRES

This volume is adapted and translated from the second editions of two English monographs, Nuclear Radiation Detectors by J. Sharpe and The Measurement of Radio Isotopes by D. Taylor.

The adapter has arranged the material in three sections, the first of which includes all the information needed for the correct measurement of radioactivity; measuring instruments, Geiger counters, etc., statistical and geometrical methods, protective shielding, etc. The third section discusses apparatus for the detection of radiation; ionization chambers, Geiger-Muller counters, scintillation counters, dosimeters, safe doses of radiation, etc.

The second section is theoretical, and explains the theories on which the operation of radiation detectors are based.

The material is presented very concisely, and there is a useful bibliography. (J. Chatelet, ed. and trans. Paris, Dunod, 1958. 321p., 3400fr.)

*METALS

Twelve papers dealing with corrosion, fatigue, and strength properties of metals. Specifically, they cover shotpeening, effect of forming on properties, axial stress fatigue, and results of studies on steels, aluminum, magnesium, and beryllium copper. (Philadelphia, American Society for Testing Materials, 1958. 175p., $4.50 s.t.p. no. 196.)

*MINING ROUND THE WORLD

A record of the struggles and achievements of miners and mining engineers. The author gives an account of the mining methods first used and how they have been developed up to the present, and in addition she examines the nature and contemporary role of such key minerals as uranium, tin, copper, lead, silver, zinc, diamonds and gold. (June Metcalfe. Toronto, Oxford, 1956. 123p., $2.50.)

*NOTES ON ANALOG-DIGITAL CONVERSION TECHNIQUES

Presents the subject matter in three parts. The first discusses systems aspects of digital information processing which influence the specifications for analog-to-digital and digital-to-analog conversion devices. In the second part a detailed engineering analysis and evaluation of a variety of conversion devices is presented. The third part is devoted to a case study based on development work done at the Servomechanisms Laboratory of the Massachusetts Institute of Technology. The book has been reprinted with corrections from the edition published by the Technology Press of Massachusetts Institute of Technology in 1957. (Ed. by A. K. Susskind. New York, Wiley, 1958. Various paging, $10.00.)

*NUCLEAR REACTOR EXPERIMENTS

Problems relating to the design, construction, and operation of nuclear reactors are outlined with details of equipment and experiments. Areas included are nuclear radiation detection, moderator and sub-critical assemblies, cross sections, operating reactors and their characteristics, heat removal from a reactor, corrosion and radiation effects, fuel preparation, and separation processes. (The Staff

THE ENGINEERING INSTITUTE LIBRARY

The publications mentioned in these Notes are now available in the Library. Members of the Institute may borrow books, periodicals, pamphlets, etc. from the Library. The loan period is two weeks, excluding time in transit, and two items may be borrowed at one time. Library hours are: Monday to Friday: 9 a.m. – 5 p.m.

Because of a recent change in policy, publications (except periodicals published by other engineering societies) may no longer be purchased through the Library. If members have difficulty obtaining material locally, it is suggested they write to the Library, and the enquiry will be forwarded to an appropriate bookseller. For further information write to the Librarian.

• LIBRARY NOTES

of the Argonne National Laboratory. Toronto, Van Nostrand, 1958. 480p., $7.25.)

*THE OILMAN'S BARREL

A short history of the standard oil barrel, the units which make it up, and the legalities connected with it. It contains historical sidelights on the petroleum industry in its early years and of the quest for scientific accuracy in gauging oil. (R. E. Hardwicke. Toronto, Burns and MacEachern, 1958. 122p., $4.75.)

LES PILES ATOMIQUES A NEUTRONS LENTS

This brief account of thermal neutron reactors will be useful to those wanting an overall view of the subject, as well as to students and specialists interested in theories.

The author has based his work on several texts published in the United States, which he cites in his introduction. The treatment of the subject is essentially theoretical and mathematical. (J. Maurin. Paris, Dunod, 1958. 197p., 980fr.)

PRECIS D'ENERGIE NUCLEAIRE, 2ND ED.

The field of nuclear energy is expanding so rapidly that the authors have thought it advisable to bring out a revised edition of their work. New topics covered include: kinetics of nuclear reactors, and the means of regulating the different classes of reactors: a comparison of the different types of reactors; the method of ascertaining the absorption of radiation, and the application of nuclear energy to power production and to transportation.

This is an introduction to the subject of nuclear energy, and its first chapter consists of a survey of modern physics, a knowledge of which is essential to an understanding of nuclear physics. Other chapters cover: the elements of nuclear physics; nuclear reactors, construction and operation; fissionable materials; radiation, its measurement and effects, and protection measures; industrial uses of nuclear energy and radioactive materials. (G. Cahen and P. Treille. Paris, Dunod, 1958. 356p., 3100fr.)

PROSPECTION ELECTRIQUE PAR COURANTS CONTINUS

The first of a series of manuals on geophysical prospecting, this volume is concerned with the various methods of geoelectrical exploration. Geophysical prospecting has been given a great impetus by the search for new sources of oil, and the methods used in this type of exploration can be applied to the fields of mining, public works, hydrogeology, etc.

The methods studied include potential gradient, resistivity, potential drop ratio, the use of the phenomena of spontaneous polarization, and induced polarization.

The author is the chief engineer of the Bureau Minier de la France d'Outre-Mer. (Pierre Lasfargues. Paris, Masson, 1957. 290p., 3000fr.)

*REGISTER OF DAMS IN THE UNITED STATES

In anticipation of the holding of the next International Congress on Large Dams in the U.S., this extensive compilation has been prepared, presenting essential statistics on over 2,800 important dams in the U.S.—completed, under construction, and proposed. The main part of the book is an alphabetical listing of the dams, giving location, structural data, reservoir capacity, ownership, by whom the engineering was performed, and the construction contractors. Additional data: a section containing photographs of over 300 dams; lists of the 100 highest and 100 largest dams, and of the 100 largest reservoirs: an alphabetical list of reservoir names; and a summary of the laws of all 48 states dealing with the supervision and control of dams. The book is sponsored by the United States Committee of the International Commission on Large Dams. (T. W. Mermel. Toronto, McGraw-Hill, 1958. 429p., $15.00.)

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*REINFORCED CONCRETE IN ARCHITECTURE

Studies the impact upon modern architecture of the engineering principles underlying reinforced concrete, particularly in the field of thin-shell construction. Surface-resistant forms, prefabricated and prestressed units are analysed, with many drawings and photographs to show the principles involved and their applications. (Aly Ahmed Raafat. New York, Reinhold, 1958. 240p., $15.00.)

SERVOMECANISMES: THEORIE ET TECHNOLOGIE

The first part of this text on servomechanisms is concerned with the theory of the subject, and is primarily of interest to engineers and engineering students. It explains the different methods of calculation of servomechanisms, both linear and non-linear equations and presupposes a knowledge of higher mathematics.

The second section covers the technological aspects; circuits, comparators, amplifiers and motors, regulators, etc.

A brief bibliography completes this survey of the field of servomechanisms. (M. Bonamy. Paris, Masson, 1957. 284p., 4200 fr.)

*SYMPOSIUM ON ION EXCHANGE AND CHROMATOGRAPHY IN ANALYTICAL CHEMISTRY

Papers dealing with materials available, or under development, for ion exchange and chromatography; the basic theory of their use; and examples of their application for separation and analysis of materials. (Philadelphia, American Society for Testing Materials, 1958. 57p., $2.25. s.t.p. 195.)

*SYMPOSIUM ON RADIOISOTOPES

Papers dealing with testing techniques utilizing radioisotope tracing. The wide range of possibilities are illustrated by case histories involving electroplating, the evaluation of rubber deterioration, the mechanism of detergency, and the achievement of process control by means of tracers during refinery operation. (Philadelphia, American Society for Testing Materials, 1958. 94p., $2.75. s.t.p. No. 215.)

*TELEVISION IN SCIENCE AND INDUSTRY

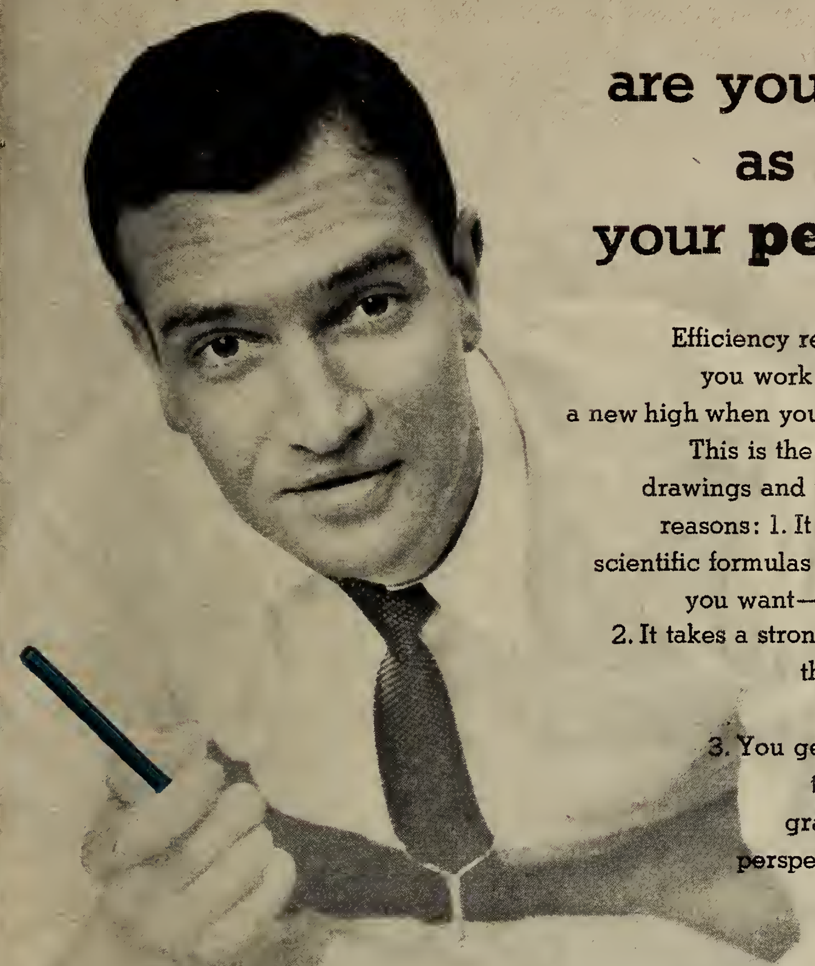
Following an introductory section on the application of television to industry, medicine, and other purposes, the equipment that has been developed is described in detail. Camera design and circuitry of conventional equipment is discussed along with colour and stereo-television apparatus, the electron microscope, and new developments in miniaturization made possible by the introduction of the half-inch vidicon and the transistor. (V. K. Zworykin and others. New York, Wiley, 1958. 300p., $10.00.)

*TRANSIENTS IN ELECTRICAL CIRCUITS

Following introductory chapters on the classical method of solving ordinary linear differential equations by using electrical circuits as examples, the Laplace transform method of solving integro-differential equations is presented. A number of applications are discussed including steady rate response to nonsinusoidal wave shapes and the extension of circuit theory methods to mechanical and electrochemical systems. The concluding chapters deal with Fourier series, integrals, and transforms in the solution of various circuit problems. (G. W. Lago and D. L. Waidelich. New York, Ronald, 1958. 393p., $7.50.)

*TRANSISTOR TECHNOLOGY, VOL. I

An extensive study dealing with the theory and fabrication of germanium transistors. This volume, which is the first of a series, presents the basic framework, and covers the technology of germanium materials, preparation of single crystals, principles of device fabrication, principles of transistor reliability. The presentation follows approximately the chronology of the development of knowledge concerning the subject. An appendix gives definitions and letter symbols relating to semiconductors. (By Members of the Technical Staff of Bell Telephone Laboratories. Toronto, Van Nostrand, 1958. 661p., $19.00.)



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Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

Eldorado Mining and Refining Ltd. — The appointment of W. M. Gilchrist as president of Eldorado Mining and Refining Limited has recently been announced.

Dept. of Public Works — E. J. Marten has been named chief of the information services for the Department of Public Works, Ottawa.

Frost Machinery Company — J. P. Frost, founder of the Frost Machinery Company Limited, Winnipeg, has retired from active business after 48 years and named his son, D. P. Frost, president and general manager of the company. R. A. W. Vidler has been appointed vice-president in charge of sales and office management.

Foster Wheeler — G. Merritt has been appointed manager of the process plants division of Foster Wheeler Limited, with headquarters in St. Catharines, Ont. He replaces B. L. Denker who has been transferred to Foster Wheeler Corporation in New York.

G. Merritt

Foundation Company Appointments — R. F. Shaw, M.E.I.C., has recently been elected president, and D. J. Watkins, vice-president, of The Foundation Company of Quebec Limited. Appointments to the Foundation Company of Ontario Limited include: G. Stewart, Toronto district manager; H. V. Koring, divisional engineer; F. G. Pumple, district manager, Sudbury district; R. N. Clark, assistant district manager, Sudbury district; J. M. Cross, district superintendent, London district.

Mersey Paper Company—J. H. M. Jones, M.E.I.C., has been appointed president and general manager of Mersey Paper Company Limited; he succeeds B. J. Waters who will remain as a director. Other appointments announced—J. A. Parker, vice-president, and G. E. Parker, woodlands manager, succeeding R. L. Seaborne who has retired.

Kramer Tractor Company—The appointment of D. E. Kramer as general sales manager of Kramer Tractor Company, Ltd., Regina has been announced by the company management. He now succeeds E. G. H. Robbins, who resigned his position to become vice-president and sales manager of Street Robbins Morrow Ltd., of Calgary.

Molson's Appointment — Announcement has been made of the appointment of C. R. Ostrom as director of production, Molson's Brewery Limited.

Abitibi Power & Paper Co. — J. G. Morrison has been named assistant manager, manufacturing — pulp and board, of the Abitibi Power & Paper Company, Limited, Toronto. T. C. Anderson, M.E.I.C., becomes mill manager, Fort William division.

Hunter Douglas Appointments — The management team for Hunter Douglas Ltd., Montreal, has been announced as follows: P. Kaye, general manager; G. B. Dobby, manufacturing manager; J. A. Bowen, marketing manager; R. C. Griffin, industrial sales manager; and J. M. Riley, comptroller.

D. J. Watkins

B. F. Goodrich — K. Norris has been named power plant engineer for B. F. Goodrich Canada Limited, Kitchener, Ont. He succeeds G. Bruce who retired after 30 years service with the company. F. D. Carney has been appointed to the newly created position of manager, sales services.

Executive Appointment — H. J. Barker has been appointed executive vice-president of Standard Telephones and Cables Manufacturing Company (Canada) Limited; he has also been appointed a director of the company.

Dosco Promotions — As part of the Dominion Steel and Coal Corporation's major reorganization program, the following personnel promotions have been made at the company's new Toronto area plant at Malton, Ont.: P. Bennett has been named general manager succeeding J. C. Coppick who becomes special consultant; E. J. Flannery becomes assistant general manager; A. K. Lajeunesse, industrial and public relations manager; J. Adamson,

● **BRIEFS**

chief accountant; C. R. Sullivan, procurement manager; and P. B. Caldwell, industrial engineer.

Canadian Westinghouse — The appointment of M. C. Lowe as manager of the power transformer division of Canadian Westinghouse Company Limited, Hamilton, has been announced. J. H. Goar, JR.E.I.C., becomes sales manager for the division, and D. Lee, engineering manager. Also announced is the appointment of E. P. Zimmerman as general sales manager for the Company's consumer products operation.

Bechtel Corporation — W. K. Davis has recently been elected a president of Bechtel Corporation. He will be responsible for advanced engineering projects in the nuclear field.

Chemcell Announcement — Canadian Chemical & Cellulose Company, Ltd., has announced the appointment of D. Keefe as president of Chemcell Fibres Limited, a new company established to carry out the yarn and fibre business of its parent company. Mr. Keefe will continue as a vice-president of Canadian Chemical and Cellulose Company Ltd.

International Equipment Co. — D. Carpenter has been named manager, sales and promotion of Bull Moose cranemobiles and lift trucks for the Napanee Iron Works division of International Equipment Company, with headquarters in Toronto. D. Hampson has been appointed branch manager at London, Ont., in the industrial division of the company.

Atlas Asbestos — Announcement has been made of the appointment of W. H. Selby as western branch manager of Atlas Asbestos Company Limited. H. W. S. Grasett has been named Toronto branch manager.

Noranda Mines Appointment — J. N. Anderson has been appointed director of smelting operations for Noranda Mines Limited and its subsidiary, Gaspe Copper Mines Limited.

News of Business and Industry

U.K. Trade with Canada — John Booth & Sons (Bolton) Ltd., England, who have marketed their steel rolling shutters in Canada during the past few years, chiefly around Montreal and Toronto, are interested in increasing their export trade to Canada. They have arranged for A. V. Booth to visit Canada during the autumn of this year with the objects of assessing the market in other parts of the country, appointing further agents and meeting present and potential customers. Mr. Booth arrives in Montreal on September 18th, and his itinerary includes Montreal, Ottawa, Toronto, Winnipeg, Vancouver and Victoria, B.C.

New Location — R. C. Thurber and Associates Ltd., consulting engineers, are now located at 43 Songhees Road, Victoria, B.C., where they have their soils and concrete testing laboratory accommodated in a large new section of the premises. Headed by R. C. Thurber, M.E.I.C., personnel include D. D. Coffey, W. G. Gerry, and T. Glynn. The firm also has an office and a complete concrete and soils testing laboratory in Fort St. John under the general direction of D. N. Roberts.

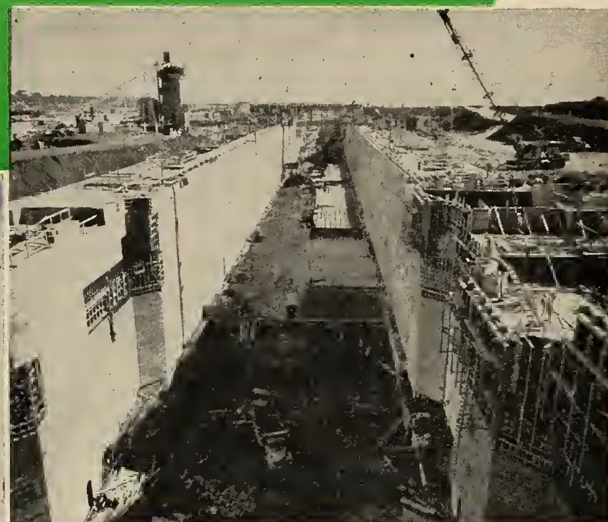
New Armco Plant — Armco Drainage and Metal Products of Canada Ltd. has announced the opening of their 9th Canadian plant, the Dawson Road plant in the Guelph industrial basin. It is designed and equipped as a modern, efficient type for production of steel drainage products. With the transfer of drainage product production to Dawson Road, the existing George Street plant, expanded several times in recent years, will afford greater production facilities for the Company's other metal products, particularly its growing "system of steel buildings". Executive offices remain at the George Street location.

New Maritimes Power Development — The official opening took place recently of the New Brunswick Electric Power Commission's Beechwood Hydro-Electric Development. Completed before schedule by the Maritimes branch of The Foundation Company of Canada Limited, the huge turbines on the project first went into operation in November of last year. The new power development is located on the St. John River ninety miles upstream from Fredericton and sixteen miles from Perth, and commands the outflow of a watershed of some 26,000 square miles.

U.S. Navy Award to Otaco — An Ontario company, Otaco Limited of Orillia, has been awarded the U. S. Navy's Certificate of Merit for "outstanding contribution" to the Department of the Navy. Believed to be the first time a Canadian company has been so honored, the award recognizes Otaco performance in supplying heavy-duty sleds for Navy use in Little America. The sleds, used in the 600-mile trek to a U.S. geophysical expedition near the South Pole, had to withstand the stresses of 20-ton loads carried over rough terrain at temperatures as low as 70 degrees below zero. The problem was met by fabricating essential sled parts at Otaco from ductile iron, a new cast material developed by the International Nickel Company.

Canada Iron Foundries Expansion — Canada Iron Foundries, Limited, Montreal has recently purchased Western Bridge & Steel Fabricators Ltd. Vancouver. At the same time, Canada Iron

ST. LAMBERT SEAWAY LOCK



The electrical lighting, power to operate the St. Lambert Seaway Lock, located on the South Shore of St. Lawrence River, near Montreal Victoria Bridge, is NOW BEING INSTALLED by

METROPOLE ELECTRIC INC.

- Highly trained and qualified persannel.
- Guaranteed highest standard af workmanship.
- Canstant supervisian by skilled prafessional engineers.
- Faithful performance af yaur plans and specifcatons.

METROPOLE ELECTRIC INC

MONTREAL — QUEBEC — OTTAWA

• BRIEFS

Foundries have also announced their purchase of C. W. Carry Ltd., Edmonton, and Calgary Structural Steel Ltd., Calgary. These three companies become members of The Canada Iron Group of Canada-wide industries, which means that Canada Iron will now have steel fabricating plants operating in Vancouver, Edmonton, Calgary, Toronto, Ottawa, Montreal and Halifax.

New Foundation Subsidiary—The formation of a new subsidiary, The Foundation Company of Quebec Limited, has been announced by The Foundation Company of Canada Limited. The company will have its head office in Montreal, and will be headed by R. F. Shaw, M.E.I.C., executive vice-president of the parent company. D. J. Watkins has been named vice-president and general manager: other officials include J. F. Masterson, vice-president; E. T. Grearson, secretary; W. J. Daly, treasurer. J. F. Benjafield, M.E.I.C., has been appointed district manager.

Parts & Service Centre—A sign of expansion at General Motors Diesel Limited, London, Ont. is the recently completed parts and service centre, situated east of the main plant and offices. With a floor area of 34,650 sq. ft. the warehouse section stocks parts for customers. Facilities for receiving and shipping include a recessed track capable of handling two railroad cars and up to three trucks. New type dock ramps, operated by counterbalances, automatically compensate for changes in the height of the truck racks as they are loaded or unloaded.

Automatic Letter-Sorting Machine — Automation has come to one of the United States' busiest post offices. In ceremonies on the work floor of the City Post Office recently, a chrome-plated electromechanical letter-sorting machine that is handling more than a quarter of a million pieces a day, was placed in official operation. Built by a Belgian subsidiary of Standard Telephones and Cables Mfg. Co. (Canada) Ltd., the semi-automatic machine permits each of six operators, sitting at keyboards, to sort 3,000 letters to 300 destinations every hour. It is being used to sort mail from the Washington Post Office to all principal cities in Virginia and many states throughout the country.

Iron Ore Processing—Developments in Canadian iron ore processing prompts Allis-Chalmers to extend pilot plant operations at Carrollville, 15 miles south of Milwaukee. The plant's larger and improved equipment will make possible expanded activity in the processing field. The facilities will be adaptable to almost any process involving burning materials in a rotary kiln. One would be the burning of lime, quantities of which are used in the chemical, paper manufacture, and water conditioning industries. However, the main work will be on iron ore processing and manufacture of cement clinker.

New Basic Industry at Dawson Creek—Canadian Liquid Air Company Limited

recently announced that construction of a new manufacturing plant for oxygen and acetylene will start this season in Dawson Creek, B.C., bringing to 44 the number of production installations established by Liquid Air. Initial investment will be in excess of a quarter million dollars. From its Dawson Creek plant Liquid Air will serve users of compressed gases and welding products in north-eastern British Columbia, the Peace River area or north-western Alberta, and the rapidly developing Northwest Territories, Mackenzie River Valley, and Yukon Territory.

"Dyfoam" Distributor—Appointment of Dominion Tar and Chemical Company as exclusive Canadian distributors of "Dyfoam," the new light-weight, expanded polystyrene, has been announced. The building supplies division of the company will handle the new product recommended for refrigeration and perimeter insulation and general building construction as well as for the buoyancy and novelty fields. Dyfoam is said to have exceptionally low thermal conductivity (K=0.25 at 40° F.) and high compression strength, and at the same time to be extremely light in weight (1 lb. per cu. ft.). It is claimed that, because of its resiliency, Dyfoam does not splinter or crack in handling or application.

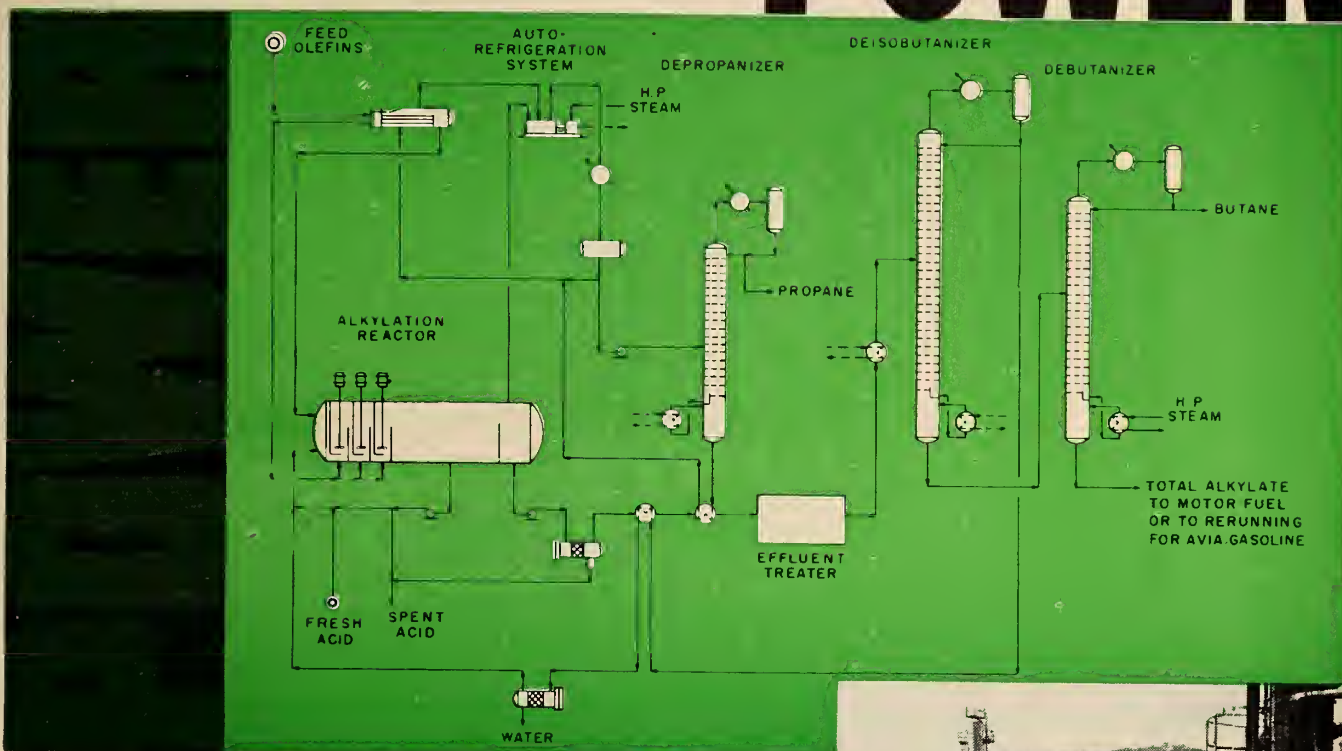
Expanded Erco Technical Facility—The Electric Reduction Company of Canada, Ltd., Toronto, will expand its present chemical research facilities 100% by February, 1959, according to a recent announcement from the company. Electric Reduction Company is one of Canada's leading suppliers of phosphoric acid, sodium and calcium phosphates, organic phosphates, and sodium and potassium chlorates with plants at Buckingham and Varences, P.Q. and Vancouver, B.C. The department will be established in its own building in Toronto and its facilities will aid in maintaining the company's contribution to research in pulp and paper, uranium extraction, mining and metallurgical, paint, petroleum, plastics, detergent, metal finishing, food processing and agricultural industries in Canada.

Nuclear Power Station — The Taylor Woodrow Group, which consists of over 40 subsidiary or associated companies operating throughout the world, report that among other projects in hand is the building and civil engineering work on the world's largest nuclear power station, Hinkley Point, designed by the English Electric-Babcock and Wilcox-Taylor Woodrow atomic power group in association with the Central Electricity Generating Board. Work on this is well in hand, reports Taylor Woodrow, an excellent start on construction having been facilitated by the speedy execution of the six-mile access road contract.

Lighting Research — The first research laboratory in the Canadian lighting industry was officially opened recently at the plant of J. A. Wilson Lighting & Display Limited in Toronto. The new laboratory provides complete up-to-date facilities to investigate the performance of lighting units and light sources. Constant investigation and control of materials will provide a means of increasing the efficiency and comfort factors in lighting. Temperature testing is conducted to the requirements established by the Canadian Standards Association. A unique feature is that customers may witness or conduct their own tests on lighting products and make comparisons.

New Technical Laboratory—Du Pont of Canada (1956) Limited announced recently that a technical laboratory costing about $700,000 will be built at its Maitland Works, on the St. Lawrence River between Brockville and Prescott, Ont. The two-storey brick and concrete structure, 150 by 85 feet, will house general purpose laboratories, two-man research units, a metallurgical laboratory, a two-storey semi-works area, library, conference room and offices. The present technical laboratory then will be used as an addition to the Works' analytical laboratory which performs much of the routine chemical analyses for the plants on the Maitland site. Since opening of the original nylon intermediates plant at Maitland in 1953, two additional plants have been erected on the site and a third is under construction. The additional plants produce "freon" fluorinated hydro-

Alkylation points the way to POWER



Power to win the Octane Race

The pace-setters in the octane race are adding alkylate to their gasoline pools. Alkylate raises the octane number where it counts—on the road.

In the refinery, Kellogg's Sulfuric Acid Alkylation process has proved to yield a superior alkylate. Measured by every standard—by quality and quantity of yield . . . by initial investment . . . by operating costs—Kellogg's process gives optimum results.

Kellogg offers unequalled experience in this field. Present advanced designs, utilizing a unique multiple-stage cascade reactor and auto-refrigeration system, provide greater isobutane efficiency, low acid consumption, minimum investment in recycle and auxiliary equipment and lower power costs.

Canadian Kellogg welcomes the opportunity to discuss its alkylation process in detail . . . and to acquaint refiners with improvements its engineers are continually making.

TYPICAL YIELDS

Olefin Feed Type	Propylene	40%C3—60%C4—	Butylenes	Pentenes
Yield-Bbl. Alkylate per Bbl. Olefin	1.78	1.74	1.72	1.60
Isobutane Consumption Bbl. iC_4 per Bbl. Olefin	1.275	1.174	1.106	0.965
Acid Consumption (Avg.): Lbs. 98% H_2SO_4 per Gal. Total Alkylate	2.5-0.84	1.5-0-6	0.84-0.33	1.0-0.4
338°F. End Point Alkylate Quality: F.-1 Research Octane No., Clear	89-92	92-95	94-97	90-93
+3.0 ccTEL	101.5-103.0	103.5-105.0	104.2-106.3	103-103.6
F-2 ASTM Octane No., Clear	87-90	90-93	92-94	90-92
F-3 (1-C) Performance No., 4.6cc TEL	117-122	124-127	127-132	116-123
F-4 (3-C) Performance No., 4.6cc TEL	129-142	141.6-154	150-165	136-148

Latest Canadian Kellogg Alkylation Unit constructed at the British American Oil Company Limited refinery in Vancouver.

Our affiliates, T. I. W. Western, Ltd., Edmonton, Alberta, with their modernized and expanded plant facilities, are well qualified to look after your fabrication needs.

The **Canadian Kellogg**

COMPANY LIMITED—TORONTO, ONTARIO

OIL — CHEMICAL PLANTS · REFINERIES · POWER PIPING carbons, gases used in the refrigeration and aerosols industries, and "orlon" acrylic fibre used by the textile industry. The third, scheduled to go into operation this summer, will produce hydrogen peroxide.

Distillate Hydrodesulphurizer—Shell Oil Company of Canada, Limited, announce that they will build a distillate hydrodesulphurizer at their Shellburn refinery, North Burnaby, B.C. A contract for the construction of the new unit has been awarded to the Fluor Corporation of Canada, Limited. Shell Oil state that construction will be completed by February, 1959. Total cost of the project including the addition of necessary auxiliary equipment is in excess of $2 million. The operation, called trickle-phase hydrodesulphurization, employs a patented Shell process designed to reduce the sulphur content of distillate oils. The company state that it is a process which is becoming increasingly important in the production of fuels of still higher quality for future diesel, heating oil, and aircraft applications.

WHERE ARE OUR BANNERS?

Headquarters regrets having to report that during the last night of the Annual Meeting at Quebec City in May, 1958, the four large Engineering Institute banners disappeared from where they were hanging, and have not been seen since.

These banners are expensive and difficult to obtain and the task of replacing them would not be an easy matter. If any members know of their present whereabouts they are urged to have them returned at once to Institute Headquarters in Montreal.

Sewer Project—Construction of the new Humber Valley trunk sewer for the municipality of Metropolitan Toronto, one of the most ambitious pollution control programs ever undertaken on this continent, is now proceeding. The two-mile conduit, large enough to drive a car through, will serve 50,000 acres with 350,000 residents; an anticipated population of 800,000 within a few years. Because of the developed residential area it penetrates, Metropolitan Toronto authorities called for an alternative to the conventional drill and blast method of tunnelling. The contractors for the Humber sewer project, The Foundation Company of Ontario, developed, in collaboration with J. S. Robbins, designing engineer, a 60-ton, 25 foot machine which is now boring steadily through rock fifty to a hundred feet below ground, undetected by thousands of residents in the immediate vicinity.

Long Safety Record—Consolidated Mining and Smelting Company employees worked 36 consecutive accident-free days in April and May, according to a company release. The record was established by a force of over 7,000 men involved in mining, plant and shop work and totals 1,404,576 man-hours. The best previous company record was 16 accident free days, a mark set in 1953.

New Polyethylene Film Plant—Visking's new polyethylene film plant is now operating in greater Winnipeg, according to an announcement from the Visking Company, Division of Union Carbide Canada Limited. The Winnipeg plant is Visking Company's second polyethylene film plant in Canada; the other film operation is at Lindsay, Ont.

Electronic Communication System — A new British electronic communication system which many experts believe to be one of the most important advances in its field for many years, has recently been opened. "STRAD", as the new system is called, is made by the British associate of the telecommunications company Standard Telephones and Cables Mfg. Co. (Canada) Ltd. "STRAD" stands for Switching, Transmitting, Receiving and Distribution System. Its job is to make a decisive reduction in the time taken to handle the many telegraph messages vital to the control of modern aircraft, a fundamental necessity in the new jet

age. Messages from many sources overseas pour into "STRAD" where they are recorded, sorted into their proper priorities and directed to the correct recipients or, if required, to many recipients simultaneously. This switching and sorting function is carried out at high speed by the electronic devices which are built into the system.

Bestpipe Expansion — A concrete pipe manufacturer, Bestpipe Ltd. of Kitchener, Ont., has recently added 7,500 sq. ft. of new manufacturing space to their Kitchener plant. Bestpipe develops and manufactures the 6 ft. pipe in sizes up to 84 in. and the 8 ft. pipe in sizes 18 in. to 36 in. Along with the 6 and 8 ft. pipe, Bestpipe has introduced the press-seal rubber concrete pipe gasket joint to Canada.

New Equipment and Developments

Welding Products—The development of two new welding products has been announced by The International Nickel Company, Inc. The new products are Inco-Weld "A" wire, for welding of dissimilar alloys by the inert-gas welding process, and Inco-Hard "1" electrode, for hard-surface overlaying of low-alloy steels and cast irons. Developed at Inco's Bayonne, N.J., research laboratory, each of the products are said to offer specific advantages for the welding field.

Photo-Recording Paper — A new photo-recording paper which is said to be capable of providing an instantaneous visible record of instrumentation tests data, is now availablee from Canadian Kodak Co. Limited. Designated as Kodak linagraph direct print paper, the new photo-recording material may be used in conjunction with several new, special-type moving-mirror galvanometer oscilligraphs. Kodak points out that the new paper should find wide application for immediate read-out of test results in the missiles and aircraft field, oil exploration, automatic, medical, nuclear, and many other control, production, and computing.

New Tooling Compounds — Two new two-component (steel oi aluminum and epoxy-type resin) punch-and-die materials designated as "3M" brand tooling compounds 113 and 112 have been announced by the new products division of Minnesota Mining and Manufacturing of Canada Limited. According to the company, these tooling compounds require no critical weighing, mixing nor timing, thus needing no special equipment. Unused portions of both parts can be returned to their containers for future use. There are no pot-life problems nor toxicity hazards to trouble the tool maker. Also, semi-skilled labour can be easily trained to use the material.

Airborne Profile Recorder — Canadian Applied Research Limited, Toronto, announced recently that its MK5 airborne profile recorder has been installed in specially designed Lockheed prop-jet aircraft for a U.S. Air Force mapping project. The airborne profile recorder, designed and built in Canada by CARL, is an improved precision radar designed for air survey work, and measures and records the rise and fall of land the aircraft is flying over. It is capable of measuring topography from 1,000 to 35,000 feet with a high degree of accuracy, and provides two records simultaneously on a paper chart recorder. One record gives the height of the terrain beneath the aircraft in reference to sea level; the other gives the distance between the aircraft and the ground.

New MIGet Aircomatic Gun — Air Reduction Canada Limited is introducing to the Canadian welding trade a new aircomatic gun and the control unit known as the MIGet. Airco pioneered the aircomatic metal inert-gas process ten years ago The new light-weight portable MIGet handgun is said to make the hardest-to-reach joints a simple matter. Continuous wire feed, from a spool in the gun, is claimed possible at speeds up to 400 in. per minute. Wires of 3/64"

Jet Piercing is a development of Linde Air Products Company, Division of Union Carbide Canada Limited

3,000° F. JET FLAME DRILLER

... relies on tough Goodyear Hose

To increase tempo of blasting schedules on the St. Lawrence Seaway and Power Project, a Jet Piercing machine was used. The Jet Piercer literally burned blast holes in the hardest spallable rock formation up to 12 times faster than any other method.

Here's how it works: A burner, suspended from a long tube combines oxygen with a petroleum base fuel to produce a jet-type flame of well over 3,000° F. that disintegrates or spalls rock in its path. The force of burning gases, plus steam formed from cooling water which flows to the burner, carry the spalled particles out of the hole.

The problem was to supply fuel to the burner. Hose was the answer but exposure to steam, fuel, oxygen and searing hot abrasive particles played havoc with ordinary hose.

The Goodyear Representative analyzed this situation and recommended that Emerald Cord Hose be used. This super-tough, oil-resistant hose takes rough treatment in stride . . . lasts for months . . . is now included in standard specifications.

If you are ever in doubt of what hose to use, call the Goodyear Representative at . . . Moncton, Saint John, Quebec City, Montreal, Toronto, London, Windsor, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Vancouver, or Head Office . . . New Toronto.

INDUSTRIAL RUBBER PRODUCTS ENGINEERED FOR THE JOB

GOODYEAR

THE GREATEST NAME IN RUBBER

and 1/16" diameter in aluminum and 3/64" diameter hard wires are available in one pound spools making the total weight of the gun 4½ pounds.

Air-Cooled Diesel Engines—Rushton & Hornsby Ltd. have extended their range of air-cooled engines with two new diesels identified as the 'YWA' and the 'YDA', and these new units embody all the design features which past experience has revealed to be desirable. The Class 'YWA' is a 4-cycle air-cooled engine of 4 in. bore x 4⅛ in. stroke, manufactured in 1 and 2 cylinder sizes providing a power range from 6-24½ b.h.p. at an automotive rating over a speed range of 1000-2200 r.p.m. The British Standard rating is from 6-19 b.p.h. at 1000-1800 r.p.m. The class 'YDA' is a 4-cycle air-cooled engine of 4⅜ in. bore x 5 in. stroke, manufactured in 2, 3, 4 and 6 cylinder sizes, providing a power range from 16-110 b.h.p. at an automotive rating over a speed range from 1000-2200 r.p.m. The British Standard rating is from 16-87 b.h.p. at 1000-1800 r.p.m.

New Pressure Regulator—A new development in a single-stage pressure regulator has recently been brought about by design engineers of Canadian Liquid Air Co. Ltd. The main feature of this new regulator is an inexpensive replaceable cartridge which contains all the vital components. Now, with only one spare part, over 90% of all normal regulator repairs can be made in a few minutes by anyone, Liquid Air states. A simple key or tool will remove the defective cartridge which can be replaced by a new one in a few minutes. This feature, exclusive to Liquid Air regulators, has been adopted for both the oxygen and acetylene single-stage L.A. regulators.

Airborne Television Transmitter—A low-power television transmitter has been developed by Electronics Development Co. Inc., of North Hollywood, Calif. Incorporating a wideband sub-carrier channel diplexed as a part of the video signal, the unit may be used to transmit a high resolution 6.5 mc. television picture complete with sound, or for transmission of fast rise data pulses combined with telemetered information. Amplitude modulation is employed between 370-450 mc. Canadian representative: Tele-Radio Systems Ltd., 3534 Dundas St. W., Toronto 9.

"Secar 250" Hydraulic Binder—Ciment Fondu Lafarge (Canada) Ltd. announce availability in Canada of Secar 250, a super-duty high purity white calcium-aluminate hydraulic binder, with less than 1% iron compounds and silica, providing service temperature to 3300° F. The introduction of Secar 250 will answer many problems formerly confronting the refractory concrete user, particularly resistance to slag, spalling and corrosive atmospheres, the company claims.

As Secar 250 and Ciment Fondu are complementary to one another, the refractory user now has the choice of two aluminous cements, which between them will make refractory concretes (refractory castables).

Speed Reducers—Foote duti-rated shaft mounted speed reducers with capacities from ¼ to 40 h.p. are now offered through their distributor Jeffrey Manufacturing Company Limited of Montreal, with branches and distributors throughout Canada. An important design feature of the new units is the incorporation of Foote Bros. duti-rated lifetime gearing, which is high hardness, high capacity gearing designed to provide optimum power transmission efficiency and service life.

Heavy-Duty Foot Switches—A redesigned line of heavy-duty, foot-operated switches to meet a greater variety of operating needs has been announced by the Allen-Bradley Canada Ltd., Galt, Ont. The Bulletin 805, Style A, foot switch base and cover are sturdy, lightweight aluminum die castings. Three different styles are available to provide a guard extending over the top of the foot treadle, a guard covering the top and sides of the treadle, and an open treadle. The broad treadle is easy to reach and is placed close to the floor to minimize operator fatigue.

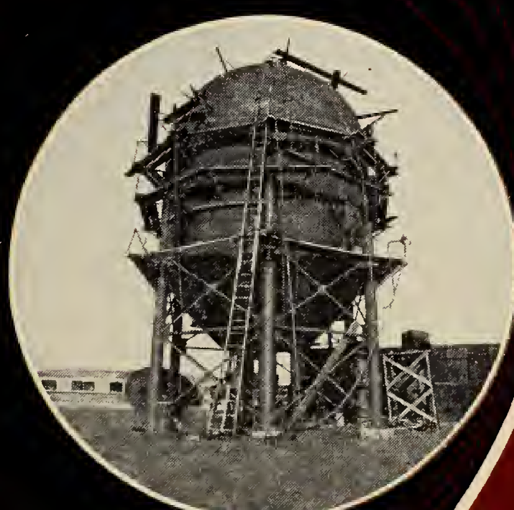
Motor - Alternator Set — The British Thomson - Houston Company has announced a new type of vertical medium rating (75-300 kW) high - frequency generating equipment for induction heating and melting applications at a frequency of 8.7 Kc/s. The new motor-alternator set, being arranged for vertical operation, is said to occupy far less space than a normal horizontal machine of the same rating. Furthermore, it is claimed to be very quiet in operation.

Electronic Scales — Philips Electronics Industries Ltd., Toronto, have recently announced the availability of custom installations of electronic scales. These scales will eliminate entirely all moving parts in the balancing mechanism which is therefore completely free from wear and resulting maintenance. The object to be weighed is either placed on or supported by one or more strain gauge load cells which are individually sealed against moisture and dust. The company claims the load cells are so constructed that no maintenance of any kind will be required for years.

Tilting Motorbases—The latest addition to the Lovejoy line of tilting motorbases is known as model 203, and is especially designed for motors from 1 to 3 horsepower. It is made to fit both old and new NEMA frame sizes. Model 203 is said to have positive tilt operation through a very practical spiral screw mechanism, which increases or decreases the distance between drive and driven pulleys and provides easy means of belt tension adjustment without the need of an idler. Where cone step pulleys are used, this feature can well be appreciated by anyone who has had to deal with this type of work. The Lovejoy line is distributed

plate-design
fabricating
erection
by

SPARLING TANK
& Mfg. Ltd.



NEW TORONTO ONTARIO

● **BRIEFS**

in Canada by Irving Smith Limited, Montreal 28.

New Product—Production of oxygard, ditertiary-butylpara-cresol, has commenced at Naugatuck Chemicals plant, in Elmira, Ont., according to an announcement by the Naugatuck Chemicals division of Dominion Rubber Company Limited. Oxygard is a technical grade antioxidant for industrial applications, supplied in a non-dusting flake form. It is used in gasoline and lubricants as a general antioxidant and gum formation inhibitor. In the plastics industry it is finding application as an antioxidant for polyethylene and high impact polystyrenes, while it is also used in rubber product manufacture as a non-staining and non-odorous antioxidant.

New Rex Truck Mixer—High-speed cycle, along with achievements in design and operational simplicity, keynote the new Rex 6-yard adjusta-wate moto-mixer, now in production by Chain Belt (Canada) Ltd. Styling of the new model shows modern, functional treatment, resulting in easy operation and clean-up. There is new single-lever operation and a newly designed instrument panel with all the controls clustered close helping to insure overall operating efficiency.

Publications

Tar Derivatives — "Coal Tar Products" is a new folder offered by the tar division of Dominion Tar and Chemical Company, Limited. The folder describes available coal tar derivatives and their typical applications.

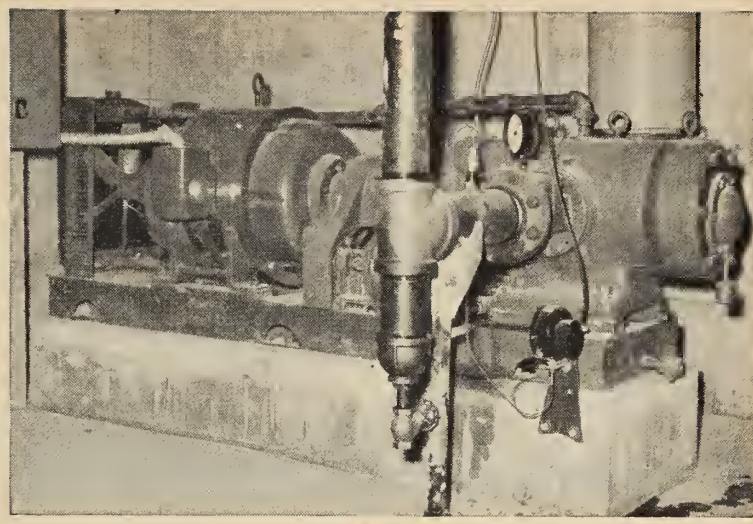
"Progress With Power" — The Canadian General Electric Company Limited has issued an attractive pamphlet, available on request, entitled "Progress with Power" which shows in graph form Canada's yearly electrical output from 1929-1957. Prepared from DBS statistics, the chart shows firm energy (total output including industrial energy, less export and secondary energy), indicating separately the amount of export and secondary energy. Sub-charts illustrate the yearly rates of growth since 1949 of utility and industrial power generation in the five principal economic regions of Canada. Another chart shows the Canadian power industry capacity from 1950-1960, based on 1957-60 estimates.

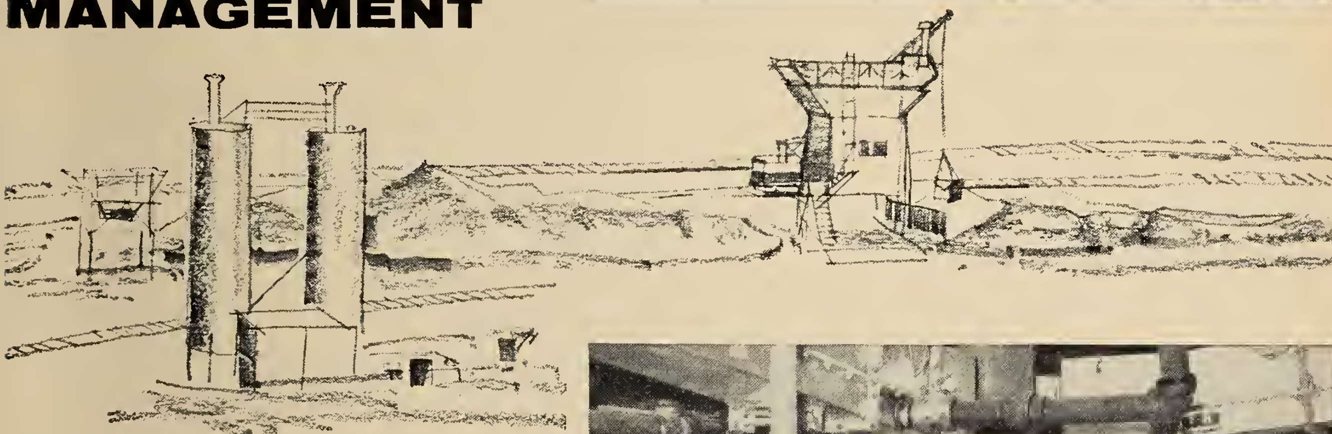
Vari-Basic Units — Performance characteristics and important dimensions of Vari-Basic blower units in No. 916, No. 1020 and No. 1220 sizes have recently been published for the first time in a six-page technical bulletin which is obtainable on request. A set of performance curves for each of two widths of each unit size gives static pressure and brake horsepower as functions of flow-rate output at four motor speeds. In addition, four tables give 15 dimensional specifications for the three Vari-Basic

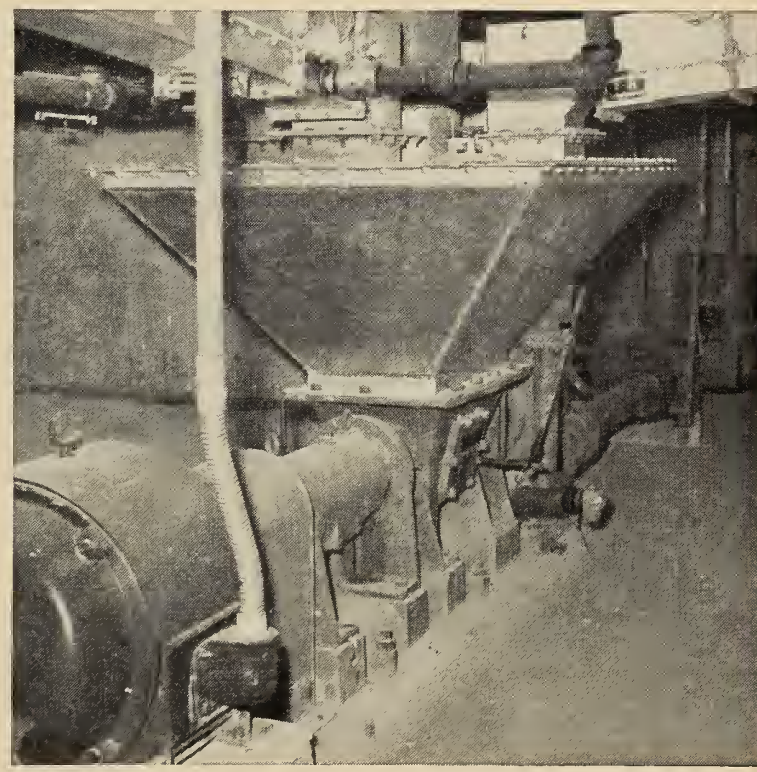
FUNCTIONAL LAYOUT

PROPER EQUIPMENT

EFFICIENT MANAGEMENT







Shown above is a fraction of the well-run S. McCord & Co. Limited yard at Rexdale, Ontario. Recently added to the McCord facilities are these two ERIE cement silos providing a storage capacity of 3000 barrels, and the ERIE Batching Plant at rear.

Cement is delivered by bulk trailers or rail cars and carried by FULLER-HURON Airslides to a 6″ FULLER-KINYON pump beneath the floor of the pump house. The cement is pumped from here to storage in the silos. Reclaiming from the silos is achieved through remote control by the batching plant operator. The FULLER-KINYON pump fills his needs through 300 feet of 5″ underground conveying line at the rate of 180 barrels per hour. This pump is powered by a 50 h.p. motor.

Air for this operation is supplied by a FULLER C-100 Rotary Compressor, a self-contained unit including radiator, fan and 50 h.p. motor.

These photographs have been left completely unretouched so that you can observe the cleanliness and compactness of this FULLER installation—typical of the many advantages of FULLER Air Handling Systems.

REQUEST BULLETIN GDM-14

Exclusive Canadian Distributors

58-14B

Construction Equipment Co. LIMITED		NATIONAL MATERIALS HANDLING LTD.	
MONTREAL	HALIFAX	TORONTO	EDMONTON
6373 COTE DE LIESSE	135 LOWER WATER ST.	402 OLD WESTON ROAD	10503-107TH STREET
TEL. ME. 1-8571	TEL. 2-6411	TEL. RO. 2-8211	TEL. 25141

XA

sizes in two widths for four discharge positions: top horizontal, bottom horizontal, upward and downward. The Torrington Mfg. Co. of Canada Ltd.

Dominion Bridge Booklet — A 64-page illustrated booklet entitled "Builders in Steel" has recently been issued by Dominion Bridge Company Limited, Lachine, Que. It provides a comprehensive account of this company's activities and its manufacturing facilities from coast to coast.

New Waldron Coupling — Peacock Brothers Limited have recently published a bulletin, No. 58, in which complete details are given on a new Waldron gear-type flexible coupling.

Cylinder Piles of Prestressed Concrete — The Raymond Concrete Pile Company have published a 24-page well-illustrated catalogue, CP-3-C, describing the Raymond cylinder piles and related prestressed concrete products.

Sewage and Drainage Pipe — The No-Co-Rode Company Limited has recently printed a new fully illustrated and detailed catalogue on No-Co-Rode sewage and drainage pipe. Available from Alexander Murray & Co. Ltd., 1661 Sun Life Building, Montreal.

Home Heating — A specially-written, thoroughly-illustrated booklet "Gurney Guide to Better Housewarming" describing how to judge the effectiveness of a home heating system, has recently been published by American-Standard Products (Canada) Limited. Explanations in simple terms, along with clear diagrams, are used to explain the network of ducts and the functions of the furnace. The booklet is obtainable free through American Standard Products (Canada) Limited, Toronto.

NEWS OF OTHER SOCIETIES *(Continued from page 156)*

The first moon rocket vehicles will undoubtedly be relatively small and rockets with sufficient power already are under construction. Convair has reported preliminary designs for a 200 foot, 90-ton two-stage chemo-nuclear vehicle capable of landing a payload of 22,000 pounds on the moon during 1958-60. Company engineers say that during 1964-70 it will be possible to land instrumented vehicles on the moon, send out manned rockets for lunar reconnaissance, and finally to land small scouting parties. A successful moon landing will require a manned-vehicle.

The US Air Force X-15 aircraft is being designed to fly short hops on ballistic trajectories up to the height of satellite orbits, but flights would be of short duration and carry out the re-entry manoeuvre on each trip. Mr. Watson believed the manned vehicle will be placed in orbit with the capability of re-entering the atmosphere at a pre-determined point.

Convair has presented a serious proposal to establish a manned space station of more than seven tons, using seven Atlas rockets to transport the component part into orbit.

To achieve travel beyond the moon, space ships would need to attain an escape velocity of seven miles per second. Because the planets travel about the sun in practically the same plane, the velocity of the earth around the sun will contribute to establishing an orbit about the sun for a space vehicle. If it leaves the earth in the correct direction, a space vehicle would require a velocity only slightly greater than the escape velocity to establish an orbit about the sun which would intercept Venus or Mars, the two planets of greatest interest to us.

Venus is on an inferior orbit to our own and Mars is on an orbit greater in diameter than ours. The first trips to the moon or either of these planets will be on a return basis in which a space vehicle might orbit about the destination a number of times and then accelerate sufficiently to return to earth. Since the moon, Venus, and Mars are all smaller masses than earth, the escape velocity and, therefore, the fuel required for return would be less than that needed to escape from earth.

Mr. Watson pointed out that for many years people have been speculating about travelling to the moon. Contributing to the difficulties of such a project is the fact that the moon has practically no atmosphere and that it is very hot during the lunar day and very cold at night. To live there would require the establishment of dwellings, workshops, and vehicles — all pressurized and air-conditioned in a fashion similar to that of high altitude aircraft.

The moon nevertheless, would offer many advantages as an intermediate station for space travel, particularly because it has an escape velocity of only 2 miles/sec. and already possesses a velocity which corresponds closely with the earth's solar orbital velocity.

The year 1958 corresponds with that period when explorers returned from the discovery of the North American Continent. Their return stimulated activity for exploitation of the New World and provided man to meet the challenge of long distance travel. Ships were improved, the provisioning of food supplies for long voyages was undertaken, improvements were made in navigational methods and many other related activities were stimulated.

The challenge of space travel lies before the inhabitants of the world today and the large rockets and earth satellites now in existence have changed this subject from one of incredulity to one of general acceptance.

On this new basis, Mr. Watson believed that rapid progress would be made in the conquest of space.

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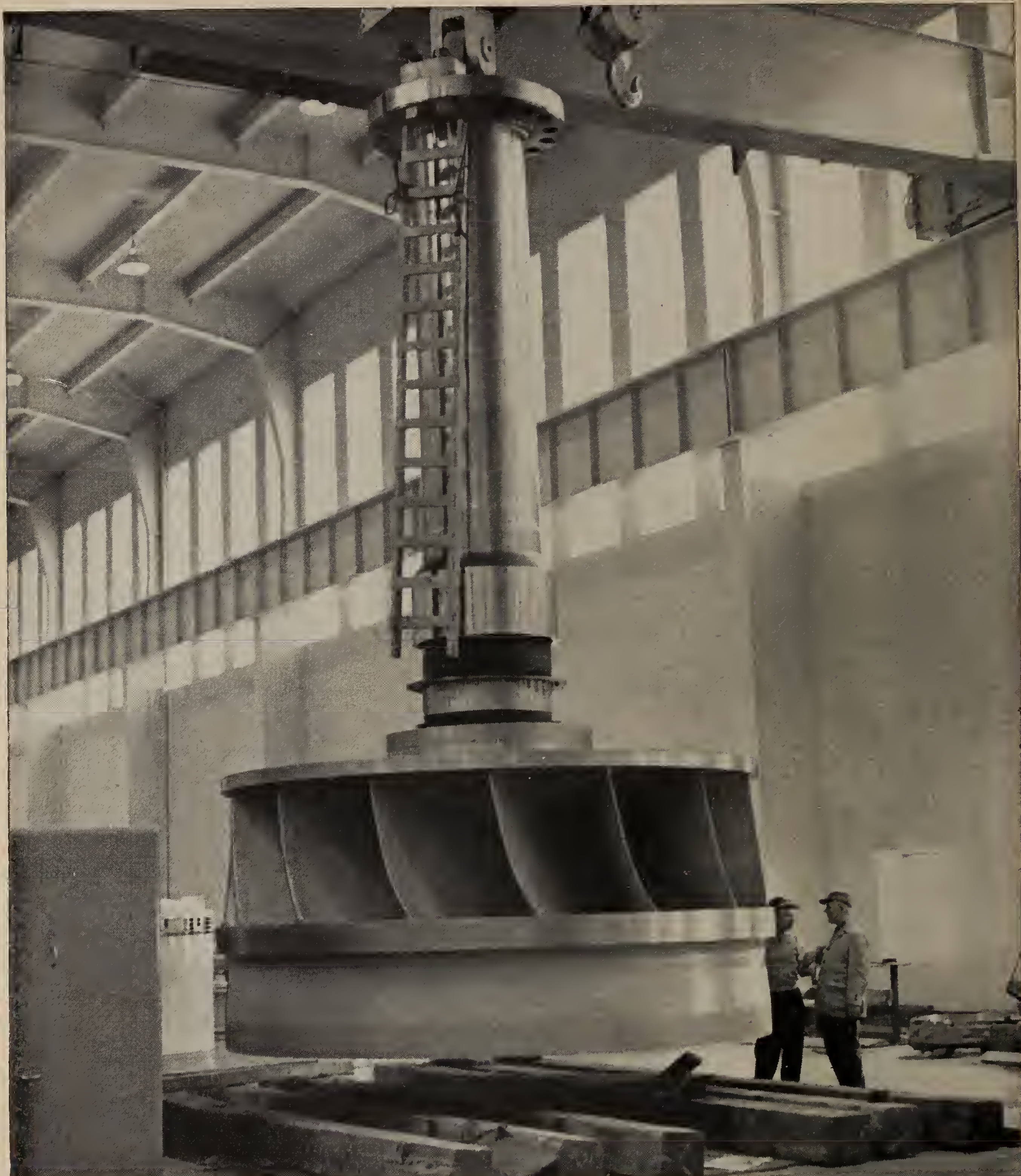


IN THIS ISSUE

During September there were many important meetings concerned with power, including the World Power Conference, Canadian Sectional Meeting; the International Conference on Large Dams; and the Geneva Conference on the Peaceful Uses of Atomic Energy.

Because of this current interest, the October issue of the *Journal* is largely devoted to the subject of power, and includes a review of recent developments in all the provinces of Canada, with a special article on nuclear power in Canada.

There are also reports of the Canadian and Geneva meetings, and the engineering problems of using tidal power are discussed in a paper on the Passamaquoddy Tidal Power Project.

MEET THE AUTHORS

Gerald Millar, Chief Engineer, Harbours and Rivers Engineering Branch, Department of Public Works, Ottawa, *(The Passamaquoddy Power Development).*

Mr. Millar studied engineering at Ecole Polytechnique, University of Montreal, graduating in 1937 with the degree of B.A.Sc.

After survey work in northern Quebec, he joined the engineering branch, Federal Department of Public Works, in June 1937 as a junior engineer attached to the Ottawa district office.

Enlisting as a sapper in the Royal Canadian Engineers in February 1943, Mr. Millar was discharged in November 1945, with the rank of Lieutenant. He then returned to the Department of Public Works and served in the Rimouski and Quebec District Offices.

Mr. Millar rejoined headquarters at Ottawa in September 1947, and served there until June 1949 when he was transferred to St. John's, Nfld., as District Engineer. In February 1955, he returned to Ottawa from Newfoundland on being promoted to the position of Supervising Engineer—Eastern region. He eventually became chief of the Maintenance and Operations Division of the Branch and was promoted to chief engineer in March 1957.

M. H. Thomas, General Superintendent, Chemical Operations, Atomic Energy of Canada. Attended University of New Brunswick, B.Sc. (*A special report on nuclear power developments in Canada*), (Hons. Chem.), University of Toronto, M.A. Physical Chem. Chief Chemist for Defence Industries Ltd. at Valleyfield and Nobel during the war years in explosive manufacturing. In 1945 with Defence Industries at Chalk River where associations have been with Chemical Control, Isotope Productions, Chemical Extraction and general chemical problems relating to Reactor Technology.

The Ontario Hydro pumping-generating station has an installed capacity of 282,000 h.p. from its six units.

POWER

A REVIEW OF RECENT CANADIAN DEVELOPMENTS

THIS REVIEW attempts only to indicate the general growth of electrical power developments in Canada during approximately the past two or three years, and to record, where possible, the major power projects that are in hand or planned for a similar period ahead. The review will discuss these power developments in each province.

It is well known that Canada has ample resources, such as water power and fossil fuels, from which to produce sufficient electrical power to meet the needs of a rapidly-growing population and industry for many years to come. However, it is equally well known that these resources are by no means all available in the right place or at the right price.

A recent estimate shows that rather less than 28 per cent of the available water power in Canada has yet been developed. There is therefore a very large potential still available, but here the 'wrong place' principle may be well illustrated by the highly-industrialized province of Ontario, which needs large amounts of power but which has already developed so much of its major water power resources within economic distances of the large load centres, that plans in the province are turning towards additional thermal stations to supply the needed power.

Coal is a suitable source of thermal energy for such stations, and at the same time Nova Scotia not only has plenty of coal, but depends to a large extent, economically, on selling it. There is little physical difficulty in moving large amounts of this coal from Nova Scotia to Ontario, particularly now that the new St. Lawrence Seaway route is shortly to be opened to traffic. However, this is where the principle of 'wrong price' is exemplified, and it is an unfortunate fact that, speaking generally, coal can be delivered to a thermal station in Ontario more cheaply from United States sources than from the Canadian coalfields.

(It is true that the government has assisted the coal industry in Nova Scotia to market at competitive prices by an appropriate allowance for reduced freight rates, but the example is true under normal conditions.)

Integration of Sources

To be more specific than the general points mentioned above, the problem of supplying power economically and reliably to both large centres and small, scattered consumers (such as in rural areas) can be resolved only after considering many inter-related physical and economic factors. Today, and looking at future demands, increasing consideration is being given to providing power from integrated systems that may combine both hydro-electric and thermal sources. In Canada, such provinces as Quebec can continue for a considerable time to rely mainly on developing their available water power resources, though such developments will almost certainly eventually be integrated into large networks, rather than being planned to serve only a specific area.

Since thermal power stations operate most efficiently at a steady load, it is often desirable, in an integrated scheme, to use thermal stations to supply the estimated steady base load, bringing in additional power to meet peak loads from the more flexible hydro-electric generating station.

Another development which is receiving wide attention is the use of pumped storage associated with hydro-electric generating stations. A notable example of this is the pumping-generating station of Ontario Hydro at Niagara Falls, Ont., which will be mentioned later.

Trend to Thermal Power

At the end of 1957, the total installed capacity of water-power plants in Canada was recorded as 19,871,008 h.p. (equivalent approximately to 14,821,800 kw.). The net generating capacity of central thermal stations in Canada in 1956 was 2,142,000 kw. (a 272 per cent increase since 1950), with a projected total, by 1960, of 4,316,000 kw. — more than double the 1956 figure.

It is estimated that the growth trend ratio of thermal to hydro-electric capacity was 1 : 15 in the ten-year period 1935 to 1945; 1 : 7 during 1945-55; will be 1 : 4 for the ten years 1950-60; and projected over a thirty year period 1951-81 will reach a ratio of 1 : 2. Thus, for the period 1950-60, the compounded growth rate for thermal power amounts to 18.5 per cent, in comparison with 7.6 per cent for hydro.

Hydro Power Growth

New hydro-electric plant capacity added in Canada was some 845,000 h.p. in 1956. Expansion was much more rapid in 1957, when a further 1,501,560 h.p. was installed, and it is expected that this figure will be exceeded during 1958 with an estimated further addition of capacity of about 2,200,000 h.p. Plans for the succeeding few years would add more than 4,300,000 h.p., according to estimates made at the end of 1957.

Table I. Hydraulic Capacity, 1957 Regional Distribution

Province or Territory	% Total Capacity
British Columbia	15.71
Alberta	1.56
Saskatchewan	0.50
Manitoba	3.90
Ontario	29.35
Quebec	45.11
New Brunswick	1.05
Nova Scotia	0.93
Prince Edward Is.	0.01
Newfoundland	1.70
Yukon & N.W.T.	0.18

A view during construction of the penstock and powerhouse of the Bowater Paper Company hydro-electric station at Corner Brook, Newfoundland. The installation has a total capacity of 12,000 h.p. from two similar units.

Distribution of Capacity

A general impression of the present relative importance of hydro-electric power in the various areas of Canada may be gained from Table I, which shows the proportion, in each province or territory, of the total installed water-power capacity at the end of 1957. This total, as mentioned above, was 19,891,008 h.p.

An exact comparison is not readily available for the regional distribution of total thermal-electric installed capacity at the same period. However, considering only the major thermal plants operated by the Canadian central electric station industry, details of about 1775 megawatts of total installed capacity are available for 1957. (This should be contrasted with the total thermal capacity of 2142 Mw. in 1956.) Of this 1775 Mw., the percentage distribution between provinces was: British Columbia 0.61; Alberta 18.10; Saskatchewan 18.81; Manitoba 2.82; Ontario 37.50; New Brunswick 5.32; Nova Scotia 15.01; P.E.I. 1.27; and Newfoundland 0.56.

Because of the rapid growth of thermal capacity, and the current construction programs for very large plants in all the provinces from Ontario westwards to British Columbia, there will be a considerable change in this distribution in the next few years.

The major developments in the power industry will now be discussed as they occur in the individual provinces.

NEWFOUNDLAND

The potential of Newfoundland's important water-power resources has only been estimated tentatively, for lack of data on steam flow. The installed turbine capacity totalled 336,750 h.p. in 1956, but several developments and investigations since then will lead to an appreciable increase in this figure in the next few years.

Recently completed were two units for the Maritime Mining Corporation Limited: one of 460 h.p. on Venamas Brook, at Green Bay; the other of 760 h.p., also at Green Bay. This year, 1958, two new 6000 h.p. turbine units go into operation at Corner Brook for the Bowater Power Company Limited, who also had under construction a 6600 kw. standby steam unit at Corner Brook.

Several other developments were planned for completion in 1958. Newfoundland Light and Power Co., Ltd., have a 17,000 h.p. hydro development (in two units) on Rattling Rock, near Norris Arm, and an additional 20,000 kw. unit for their St. John's oil-fired steam plant. Union Electric Light and Power Co. Ltd. are to complete present expansion of the Trinity River hydro plant with an additional 2000 h.p. unit. Another hydro expansion stage will be completed with a third unit of 3600 h.p. at

Lookout Brook for United Towns Electric Co. Ltd.

The developments referred to above are on the island itself (Labrador will be dealt with separately), which has a large undeveloped water-power potential, though the largest sites are mainly inconveniently situated in relation to main load centres. The many small coastal streams, though their individual potential is small, could possibly be developed economically under specific favourable conditions.

One major development that is being actively considered by British Newfoundland Corporation Limited is at Bay d'Espoir, in central Newfoundland. With the possibility of developing industry in this area, surveys have been carried out and a scheme recommended which would give 350,000 h.p. at the site, using the watersheds of both the Salmon and Grey Rivers. The project could be developed in five stages of 70,000 h.p., the first of which could be completed a little over two years from the time construction was committed.

A reconnaissance and preliminary study of a transmission line from Bay d'Espoir to central Newfoundland has been carried out, and it is indicated that a suitable line could be built economically within the time required for completion of the first stage of power production.

Two further hydro developments are under active consideration by Bowater in the Grand Lake Watershed. One, on Hinds Brook, would be of 50,000 h.p. in two units (679 ft. head); the other, on Little Grand Lake, would be a single unit of 14,000 h.p. (205 ft. head).

In the field of transmission, the Union Electric Light and Power Company Limited is to complete 33 miles of 48-kv. line between Lockston and Clarenville, Trinity Bay.

LABRADOR

The potential for power production in Labrador differs very considerably from the situation on the island of Newfoundland. Apart from great possibilities of developing mineral resources, and the fact that is it part of the mainland, Labrador has, in the Hamilton River, a water-power potential that has been described as possibly the largest single undeveloped source of power in Canada.

Roughly 170 miles west of Goose Bay, Labrador, is the site of Hamilton Falls, which has been investigated by the British Newfoundland Corporation Limited for several years. By 1956 it was announced that it would be feasible to develop power at Hamilton Falls, and an access road was built to the site from mile 286 on the Quebec North Shore and Labrador Railway. During 1957 the 106-mile long road was improved for all-weather use. A 'catwalk' was built across the river above the Falls to help in the construction of a 25-ton transporter cableway, completed in 1957, to carry materials and equipment.

From the many surveys, engineering investigations, and cost estimates that have been made, it was confirmed that a first stage development of 1,000,000 h.p., including transmission facilities, could be completed in four years.

During development of the Hamilton Falls site on the Hamilton River, in Labrador, a 25-ton cable-way was constructed. The footbridge shown here provided initial access over the river. There is a potential of 4 million h.p. at this site.

The start of construction depends on finding customers for the power, and investigations have been made into long-distance transmission to reach the widest possible market. It has been estimated that high load factor power from the first stage might cost the consumer about 3 mills per kwh. at the busbars, and that, for a projected 4,000,000 h.p. development, the cost could be as low as 2 mills.

With a reserve of some 6,000,000 h.p., the Hamilton River is considered to be one of the few remaining sources of low-cost energy in Canada within economic transmission distance of a wide market.

PRINCE EDWARD ISLAND

Prince Edward Island has the smallest water power resources of any of the Canadian provinces. The small size of the streams limits water power sites to capacities of the order of those used for small mills.

The installed turbine capacity of 1882 h.p. represents some 48.3 per cent of the total available. Of this installed capacity, roughly one-fifth is in central electric stations, and the remaining four-fifths in other industries (which do not include pulp and paper mills).

The main producer of power is the Maritime Electric Co., Ltd., which operates a steam-electric generating plant in Charlottetown. This consists of six units, with a combined capacity of 21,500 kw. The last unit to be added was one of 7500 kw. capacity, which was installed in 1956. The first unit had been put into operation in 1926.

The only other installation of 1000 h.p. or more, at the end of 1956, was that owned by the Town of Summerside, which consisted of seven diesel-powered units (ranging from 300 h.p. to 1600 h.p.) with a total capacity of 4190 h.p.

A recent D.B.S. survey forecast that firm power requirements on Prince Edward Island would increase from 53 million kwh. in 1956 to 83 million kwh. in 1960. Maritime Electric Company plans to add a further 10,000 kw., to be commissioned in 1961, to the Charlottetown steam plant.

NOVA SCOTIA

The water power resources of Nova Scotia are the least among the Canadian provinces, except for Prince

Edward Island, and are very largely developed, though there are still plans for some major projects, as will be mentioned below. There are, however, many small rivers on which small power plants have been developed, and which are within economic transmission distance of the principal load centres.

The province has abundant indigenous supplies of coal, from which thermal power is produced to meet additional requirements.

The developed electric power generating capacity in Nova Scotia in 1957 totalled approximately 415,000 kw., of which 285,000 kw. was thermal and the remaining 130,000 kw. was generated by hydro-electric stations.

The power production in the Province in 1956 totalled approximately 1,500,000,000 kwh., hydro production accounting for 583,500,000 kwh., while thermal plants produced 916,500,000 kwh. The Nova Scotia Power Commission accounted for about one-third of the total output, or over 500,000,000 kwh., while the remainder was produced by privately owned utilities.

Probable power expansions planned in Nova Scotia in the near future by the Nova Scotia Power Commission include:

(1) Extensions to the Trenton steam plant of a 20,000 kw. unit, construction of which commenced in 1957.

(2) Hydro development on the Sissiboo River in Western Nova Scotia which will add 25,000 kw. of additional capacity to the western network.

(3) A development at Wreck Cove, Cape Breton, which promises to be the largest single hydro development in Nova Scotia to the order of approximately 70,000 kw.

The Nova Scotia Light and Power Co. Ltd., in 1957, completed construction of an additional 45,000 kw. unit at its Water Street steam plant in Halifax, and is building a similar steam unit for operation in 1959. Two units of 1150 h.p. each at this company's Hemlock Falls hydro plant are being replaced by a 5000 h.p. unit. A further prospect is a 6500 h.p. hydro-electric development at Alpena, on the Nicteaux River.

Seaboard Power Corporation Ltd. is adding an 18,750 kw. unit at its Glace Bay steam plant.

During the year 1957 steps were made towards the closer consolidation, from an operating standpoint, of the various electrical utilities in Nova Scotia and New Brunswick. The result of this will see in 1958 the beginning of construction of a high-voltage transmission link between Nova Scotia and New Brunswick, which will connect the systems of The Nova Scotia Power Commission and the New Brunswick Electric Power Commission; and, within Nova Scotia, between The Nova Scotia Power Commission and the Nova Scotia Light and Power Company. Completion date of the interconnections is set for 1 July 1959. The voltage will be either 138 kv. or 230 kv. It is estimated from recently completed studies that these transmission interconnections will save the combined electrical power systems of Nova Scotia and New Brunswick approximately $30,000,000 over the next 10 years.

The Atlantic Provinces Power Development Act was recently passed to give Federal financial assistance to the four Atlantic provinces for power development and to provide for coal subventions. The assistance is not a grant, but rather in the form of loans to provide money to the Provinces at Federal interest rates for construction of thermal power plants, and construction of transmission facilities within and between the provinces. The loans are to be repaid by the Provinces over a 30 or 40 year period. The basis of the subvention is the difference between the cost of coal delivered to thermal plants in Ontario and that delivered to thermal plants in Nova Scotia and New Brunswick.

The possible utilization of tidal power is not being overlooked in Nova Scotia. The Nova Scotia Light and Power Company have engaged consultants to investigate potential tidal sites at Minas Channel and Minas Basin, while the engineering department of The Nova Scotia Power Commission is investigating a possible project at Amherst Point in Northern Nova Scotia, and on the Annapolis River in Western Nova Scotia. The Federal Governments of both Canada and the United States are also doing extensive investigations of the tidal potential of Passamaquoddy Bay.

NEW BRUNSWICK

The water power resources of New Brunswick are small in comparison with other Canadian provinces, excepting Prince Edward Island and Nova Scotia, but much of the available power is conveniently situated for the development of moderate-sized sites within economic transmission distance of the major load centres. The most important of these developments is the Beechwood hydro-electric project on the St. John River, of which further details will be given.

As in the case of Nova Scotia, New Brunswick has indigenous coal supplies from which power is developed in thermal plants, and the future power needs of the province have been planned on the basis of large thermal units integrated with hydro-electric generating sources. Long-term plans have also considered the integration of possible nuclear energy power sources.

Hydro-Electric Developments

At the end of 1957 there were recorded nine hydro-electric installations with capacities not less than 2000 h.p. Of these, the only recent developments were the two-unit Narrows installation on the Tobique River, completed in 1953 (27,000 h.p.), and the Beechwood project, started in 1955, of which the first 45,000 h.p. unit was in operation.

The second unit at Beechwood started production in January 1958, and construction to provide for the third unit is well under way. The eventual potential of 135,000 h.p. will be derived from these three 45,000 h.p. Kaplan turbine units, operating under a head of 60 feet, each driving a 40,000 kva. generator.

Further technical details of the Beechwood development are contained in two papers which were presented at the 72nd Annual Meeting of the Engineering Institute of Canada, in May 1958. These are: 'Engineering Features of the Beechwood Development', by J. A. Thomas, M.E.I.C. and R. E. Grout, M.E.I.C.; and 'Beechwood Kaplan Turbines—Hydraulic and Mechanical Features', by L. M. Boyd, M.E.I.C. and W. S. McIlquham, M.E.I.C. It is hoped to publish some of these details in later issues of *The Engineering Journal*.

From a study started in 1952, the International Joint Commission recommended (in a report published in 1953) the Beechwood site for initial development on the main stem of the St. John River, which is one of the largest rivers draining into the Atlantic Ocean. Some difficulty in construction was to be expected because the River is liable to flash flooding, as indicated by a recorded run-off varying from 0.2 c.f.s. per square mile to 17 c.f.s. per square mile, the latter figure corresponding to a record flood of 238,000 c.f.s. at Beechwood in May 1923.

Studies show that there are four power sites on the main part of the river within New Brunswick, of which two have been developed. The first is at Grand Falls, completed in 1931, of 80,000 h.p. (57,000 kw.) at 132 feet head; the second is the Beechwood plant. About half way between these sites is Morrill, which is expected to develop some 66,000 kw. (at 53 feet head), and the fourth site is at Hawkshaw, about forty miles above Fredericton, with an anticipated capacity of 112,500 kw. from a head of 55 feet.

Within the integrated scheme, the Beechwood plant will be operated essentially as a peak load source during periods of low flow, while the thermal plants will be base-loaded.

A view at the site of the Beechwood hydro-electric power development of the New Brunswick Electric Power Commission. The installation is the largest and most recent of its type in the province, with an ultimate capacity of 135,000 h.p.

Thermal Power Generation

At the end of 1956 there were five major coal-fired steam-turbine installations in New Brunswick of capacity greater than 1000 h.p. One two-unit installation of 6050 h.p. capacity, completed in 1953, served mostly the pulp and paper industry (Fraser Companies Limited); the other four were operated by the New Brunswick Electric Power Commission. Of the latter, the most recent was a unit installed at Chatham in 1956 which brought the total capacity of that plant to 46,250 h.p.

The Power Commission has under construction a new 67,020 h.p. (50,000 kw.) steam plant at East St. John, scheduled for completion in 1959. This plant will operate at 1450 p.s.i.

Also at the end of 1956 there were six diesel-generating units of greater than 1000 h.p. capacity in the province—at Campbellton, Edmunston, Aroostock Junction, St. Stephen, Shippigan, and Grand Manan Island.

General

During the fiscal year to 31 March 1958, the total production from all generating stations of the N.B. Power Commission was 611,638,600 kwh., an increase of 8.6 per cent over the previous twelve months. Of this total production, 40.6 per cent was from hydro-electric sources and the remaining 59.4 per cent was from thermal units. The report of the Commission notes that during this twelve-month period hydro production more than doubled that of the previous fiscal period, and that the added power (from the Beechwood development) had successfully been absorbed into the system.

The introduction of power from Beechwood made possible the sale of electrical energy to the Maine Public Service at a rate, from November 1957, of up to 150,000 kwh. daily.

An interior view of the part of the Beechwood power plant on the St. John River, New Brunswick. Two units, each of 45,000 h.p., are already in operation.

Transmission Systems

The Federal Government's plan of financial assistance to the Maritime Provinces has already been mentioned with reference to the development of power in Nova Scotia, and the plans for interconnecting the electric systems of that province and of New Brunswick. The share of the interconnecting line within New Brunswick will be about 35 miles in length, from Moncton to the Nova Scotia border, and is due to be available for service by November 1959. Normal capability of the line will be 50,000 kw., with the ability of handling 75,000 kw. in an emergency.

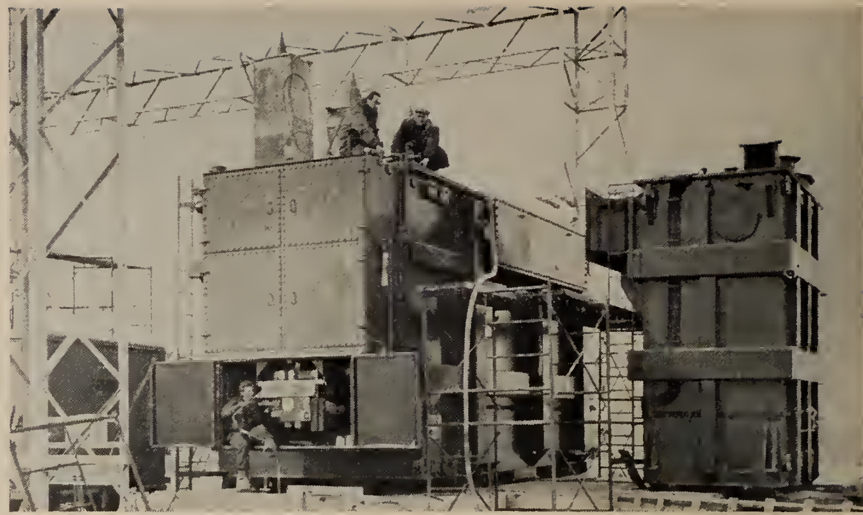
During 1957 the N.B. Electric Power Commission extended its transmission facilities by 68.4 miles of 138-kv. line from Beechwood to Fredericton and 30.4 miles of similar line from Fredericton to Grand Lake. Also, 25 miles of 69-kv. transmission line and 121.1 miles of rural distribution line were completed during the year.

Now under construction are about 190 miles of additional 138-kv. transmission line, and another substation, of 10,000-kva. capacity, at Moncton.

Three 40,000 kva. terminals were completed and energized in connection with the new 138-kv. grid—at Beechwood, Grand Lake, and Moncton. Two smaller substations completed were one of 7500 kva. at Woodstock, and one of 5000 kva. in Moncton.

The 30,000 kva. tie transformer station at Tobique now operates without having any personnel on duty at the site. Remote control equipment has been installed so that the Tobique plant staff can operate the system from Beechwood.

Low-voltage distribution facilities in the province now make electrical power available to nearly 98 per cent of the residential homes, and some 26,000 farms are supplied by the Power Commission, following an addition of about 1000 farms served during 1957.



The two installations of the Quebec Hydro-Electric Power Commission at Beauharnois have a capacity of over 1,400,000 h.p., and a third stage of 737,000 h.p. is to be added by 1960. Shown here is a 200,000 kva. transformer at the site.

QUEBEC

The Province of Quebec is the richest in water-power resources, with more than 35 per cent of the total recorded for Canada, in 1956. The province also ranks highest in developed power, and has some of the larger hydro-electric plants in the world; for example, the Hydro-Quebec development at Beauharnois, on the St. Lawrence River (1,424,000 h.p. from units Nos. 1 and 2); and the Shipshaw plant of the Aluminum Company of Canada, on the Saguenay River (1,200,000 h.p.).

Power production in the province is greatly facilitated by the regulation of stream flow by the Quebec Department of Hydraulic Resources through the storage dams it operates and controls.

Hydro-Electric Developments

At the beginning of 1957 there were completed and in operation some 93 hydro-electric installations of not less than 2000 h.p. turbine capacity. A further eight major plants were under construction, some of which are now operating, and there were plans for many other projects in this field.

When the Quebec Hydro-Electric Commission was instituted in 1944, the turbine installation in the Province represented 5,849,000 h.p. By the end of 1956, the same potential had risen to 8,417,000 h.p., which means that it had increased by nearly 50% in the space of thirteen years.

As turbine installation in Canada, at the end of 1956, represented 18,700,000 h.p., Quebec's installation was equal to around 46% of the whole country's available power. On the world scale, Quebec's developments were surpassed only by countries with a much larger population such as the United States, the USSR, France, Italy, Japan.

In proportion to the population, water power development in the Province of Quebec is the greatest in the world. In 1956 it represented 1.832 h.p. per person. Two years before that it was 1.33 h.p. per person compared to 0.73 in the United States and 0.32 in France.

In 1956, the electricity produced in the Province of Quebec represented 45% of the Canadian production, that is, 36,801,000,000 kilowatt-hours out of a total of 81,658,000,000 for the country as a whole. In 1954, a production of 35,500,000,000 kilowatt-hours meant 8,100 kwh. per person in comparison with 6,280 in Norway, 3,360 in the United States and 1,000 in France and Holland.

Because the increasingly high level of industrial activity is resulting in a constantly growing demand for electric power, the Provincial authorities and the companies which produce and transmit electricity have a number of developments under construction, some of which will eventually be among the greatest in the world.

Among the central electric stations constructed within the past ten years are: Beauharnois II, La Trenche, Chute à la Savane, Chute du Diable, McCormick, Shipshaw, Rapide II, and Bersimis I. The Bersimis development has resulted in the erection of the town of Labrieville, with modern dwellings, a church, a school, a hospital, civic, business and recreational centres, etc. When completed the underground power station at Bersimis will be capable of producing 1,200,000 h.p. generated by eight units driven by an 875-foot head of water. This project has required great feats of engineering. To raise the level of Lake Cassé and regulate the flow of the River, two dams were built, respectively 2,210 feet and 1,035 feet in length. About 200 feet high, the width of the dams at the base varies between 800 and 900 feet, and they are between 40 and 50 feet wide at the top. The dams are linked to the power-house by a tunnel 31½ feet in diameter and 7½ miles long.

The new sub-station at Pointe-aux-Trembles was built to relay to the Montreal region around 700,000 h.p. generated in the central station at Bersimis, about 450 miles away. The power produced at Bersimis will, in fact, be transmitted throughout the entire Province with the exception of the more distant northwest Abitibi regions. Since 1954, electricity generated at Bersimis has been relayed to the Gaspé Peninsula by means of the 31½ mile long submarine cable, which links the South and North Shores of the St. Lawrence, and is the longest of its kind in the world.

The Bersimis station is also linked to the Quebec region by means of a re-transmission station at Charlesbourg.

Bersimis Station No. I is about halfway toward being completed. Five of its eventual eight units of

150,000 h.p. each are in operation and three others will be installed in 1958 and 1959. This means that the work left to be done at Bersimis No. I will add 450,000 h.p. to the power now installed.

During the year 1957 alone, the Province of Quebec put into operation new installations with a potential of more than 383,000 h.p. and several other projects are being carried out. The Shawinigan Water and Power Company will complete its 330,000 h.p. station at Rapide Beaumont within the next twelve or fifteen months. A million h.p. station is being constructed by the Aluminum Company of Canada at Chute-des-Passes on the Peribonka River. The Manicouagan Power Company will add 180,000 h.p. to its McCormick station.

Price Brothers Company will shortly put into operation its new 78,000 h.p. power station at Murdoch Falls on the Shipshaw to replace its existing 10,000 h.p. plant, and the Eastern Smelting & Refining Company has just completed the installation of 42,000 h.p. on the Chicoutimi River.

Apart from completing Bersimis No. I, Hydro-Québec will speed up work at Bersimis No. II (855,000 h.p.) Beauharnois No. III (810,700 h.p.), and build a dam at the mouth of Lake St. Ann in order to regulate the flow of the Manicouagan River, which will eventually become one of the greatest sources of hydro-electric power in the Province. The preliminary estimates made along that river some years ago fixed its potential at something like 2 million h.p., but recent and more detailed surveys indicate that the Manicouagan may be capable of generating 5 million h.p. if not 6 million, which would be as much as all the power generated in the Province a dozen years back.

When all the developments now under construction are completed, that is, in 1961, water-power harnessed in the Province of Quebec will represent over 11,500,000 h.p.

For some years now, Quebec-Hydro engineers have been collecting data in connection with a plan to erect a central electric station near Lachine, just outside Montreal, which would be capable of producing 1,500,000 h.p. and another (some 500,000 h.p.) at Carillon, on the Ottawa River, about forty miles from the Canadian capital.

From the point of view of hydro-electric power Quebec is still very far from having developed even half of its resources, and the future holds promise of a much greater supply of power than has been made available to date. For although, at the end of 1957, the Province's turbine installation represented around 8,800,000 h.p., its potential is actually estimated to be some 30 million h.p. In other words, Quebec has only put to use less than a third of its recorded water-power resources.

A number of the sites recognized as capable of development are situated at great distances from the more populous regions of the Province. But electricity is now transmitted to Montreal from the plant at Bersimis, more than 400 miles away, with an average loss of less than 6%. On the other hand, the mining operations now under way in the Quebec section of the Canadian shield, can count on the plentiful supplies of hydro-electric power available there, just as the pulp and paper industry has done in other parts of the Province.

Another factor which has played an important part in the industrialization of the Province of Quebec has been the low cost of electricity. The average price of electricity is, in fact, less than half a cent per kilowatt-hour, in comparison with 4/5 of a cent for Canada as a whole, a cent and a half for the United States and two and 3/10 cents for France.

Progress at Chute-des-Passes

Construction of the one million horsepower Chute-des-Passes project of the Aluminum Company of Canada —150 miles north of Arvida, Que.— began in August 1956 with the first of five 200,000 horsepower units scheduled to go "on-power" on 1st August 1959 and the final unit on 1st February 1960, which will complete the ultimate development. This power is being developed mainly for projected additional Alcan smelter capacity in the Saguenay area and will also serve other industrial and domestic requirements.

As at the end of August 1958 excavation was complete for the intake structure, supply tunnel, surge shaft and powerhouse. In the intake tunnel, beneath the reservoir, a pilot drift has been excavated for a distance of about 200 feet ahead of the face of the top heading, of which, approximately 400 feet has been removed. Excavation operations continue in the surge tank, switchyard and tailrace aread with the top heading of the tailrace tunnel now daylighted and open cut work well advanced at the discharge location.

Over 8,000 feet of supply tunnel arch lining has been placed, and in the powerhouse, concrete work is essentially complete except for the unit concrete. Both powerhouse cranes are in operation. The installation of turbine scroll cases is proceeding and the placing of the steel penstock liners is nearly finished, with the welding and stress-relieving operations progressing rapidly.

Overall the project remains to schedule, and no change is proposed for the original "on-power" dates.

Manicouagan Power Development

The advent of the new aluminum smelter of the Canadian British Aluminium Company in the Baie Comeau area of Quebec required a suitable supply of power. The Manicouagan Power Company, which had a development on the Manicouagan River in 1951-52, largely for the pulp and paper industry further expanded this development in 1956-57 to supply the aluminium project. The story of this development has been told in *The Engineering Journal* for July 1958 (pp. 60 to 69).

Thermal Power Generation

Because of the ready availability of hydro-electric power in the province, as has been indicated above, the part played by thermal generating stations is relatively very small.

The only two recorded steam installations with a capacity of over 1000 h.p. (end-1956) were standby plants: one of 22,000 h.p. total capacity at Cedars, on the St. Lawrence River, and one of 10,724 h.p. total capacity operated by the City of Westmount (Montreal).

Five diesel-operated plants in the over-1000 h.p. range were recorded at the same period, mostly serving local needs in certain areas. Additions were made to all these plants during the years 1953 to 1955. The total capacity involved is some 19,710 h.p.

ONTARIO

About 90 per cent of the electric energy used in Ontario is supplied by the Hydro-Electric Power Commission of Ontario (more familiarly known as Ontario Hydro), which came into being in 1906 and started to supply power in 1910 from its resources of 7400 kw., all of which was purchased under contract. The Commission's first hydro-electric plant was built in 1914 at Wasdell Falls, on the Severn River.

By 1945 the Commission's resources had increased to 1,937,500 kw., but since then capacity has been increased by 150 per cent, through the addition of 15 new sources of power.

Projects now under way will bring into service during the next few years additional resources totalling nearly 3,000,000 kw. Details of these major projects are summarized in the accompanying table.

Integrated Scheme

Projected estimates suggest that the demand on Ontario Hydro will be of the order of 6,000,000 kw. by 1960, with the possibility of some 20,000,000 kw. by 1980. It was mentioned in the introduction to this review that plans are being developed in the province to integrate power from large thermal and hydro-electric sources, and it will be noted that this is the first province to make a start on the use of nuclear energy as a source of electrical power, though the first unit will be used mainly to gain experience for the future development of large nuclear plants.

Southern Ontario

In the Southern Ontario System, the main developments now under way are at the Sir Adam Beck—Niagara No. 2 generating station; the R. L. Hearn thermal station, in Toronto; and the Robert H. Saunders—St. Lawrence generating station.

At Niagara, of four 75,000 kw. generators to be added, two were in service at the end of 1957. It is at this site that the unique pumping-generating station has been incorporated. When the present additions are completed, the total installed capacity of this station will be 1,370,000 kw.

The Richard L. Hearn thermal station, with a present capacity of 400,000 kw., will have a further four 200,000 kw. units, the first to be operating in 1958, with the remaining three following in 1959 and 1960. This will bring the total capacity of the plant to 1,200,000 kw.

The St. Lawrence project, already partly in operation, will ultimately provide 820,000 kw. from 16 units. This is, of course, the Canadian half of the powerhouse in the International Rapids section of the St. Lawrence River, the other half, of equal capacity, being operated by the Power Authority of the State of New York. The progress of this development has been followed in some detail in *The Engineering Journal* since 1955, notably in the issues of September 1956, October 1957, and September 1958.

Northern Ontario

Mining developments in Northern Ontario, particularly in the Blind River area, have influenced the production of power, which has recently been accelerated in this region.

To meet these ever-growing power needs in the north, Ontario Hydro has under way a program of construction which includes the building of three new hydro-electric generating stations on northern rivers and extensions to four existing stations. At the the same time, plans are going ahead for the construction of the Commission's first thermal-electric station in Northern Ontario—in the Fort William-Port Arthur area. This plant is scheduled for service in 1961. The initial capacity with one unit will be 100,000 kw. with provision for enlarging it to 1,000,000 kw. as required.

The 54,000-kilowatt Whitedog Falls plant, on the Winnipeg River, and the 67,500-kilowatt Caribou Falls station on the English River are now nearing completion and are scheduled to come into service during 1958, while the

ONTARIO CONSTRUCTION PROGRAMME 1956-1961

Development	*Location*	*No. Units*	*Type*	*In Service*	*Capacity (Kilowatts) Present*	*Ultimate*
Southern Ontario System						
Sir Adam Beck–Niagara G.S. No. 2	Niagara River	16	H	Apr. 1954–Aug. 1958	1,200,000	1,200,000
Pumping G.S.		6	H	July 1957–June 1958	170,000	170,000
R. L. Hearn G.S. extension	Toronto	4	T	1958–1960	—	800,000†
Robert H. Saunders St. Lawrence G.S.	St. Lawrence River	16	H	July 1958–Late 1959	280,000	820,000
Nuclear Power Demonstration	Ottawa River	1	T	1961	20,000	20,000
Lakeview G.S.	Toronto Township	2	T	1961–1962	—	600,000*
Northeastern Division						
Abitibi Canyon G.S. extension	Abitibi River	1	H	1959	—	45,000†
Red Rock Falls G.S.	Mississagi River	1	H	1960	—	38,000
Otter Rapids G.S.	Abitibi River	3	H	1961	—	131,000
Northwestern Division						
Manitou Falls G.S.	English River	5	H	Mar. 1956–Apr. 1958	65,700	65,700
Caribou Falls G.S.	English River	3	H	1958	22,500 (1 unit)	65,700
Whitedog Falls G.S.	Winnipeg River	3	H	Feb.–June 1958	53,700	53,700
Cameron Falls G.S. extension	Nipigon River	1	H	Sept. 1958	19,100†	19,100
Alexander G.S. extension	Nipigon River	1	H	Apr. 1958	11,300†	11,300
Silver Falls G.S.	Kaministikwia River	1	H	1959	45,500	45,500
Thunder Bay G.S.	Fort William	1	T	1961	—	100,000*

* Lakeview—600,000 kw. in two units approved—expected ultimate capacity is 1,800,000 kw.
Thunder Bay—100,000 kw. in one unit approved—expected ultimate capacity is 1,000,000 kw.

† Abitibi Canyon G.S.—Capacity of extension only; present station capacity—181,000 kw., ultimate capacity 226,000 kw.
Cameron Falls G.S.—Capacity of extension only; present capacity of the station is 76,700 kw. including extension.
Alexander G.S.—Capacity of extension only; present capacity of the station is 60,900 kw. including extension.
R. L. Hearn G.S.—Capacity of extension only; present capacity of the station is 400,000 kw. (4 units) ultimate capacity 1,200,000 kw. (8 units), respectively.

H — Hydraulic T — Thermal

45,500-kilowatt Silver Falls development on the Kaministikwia River is expected to be in operation by the fall of 1959.

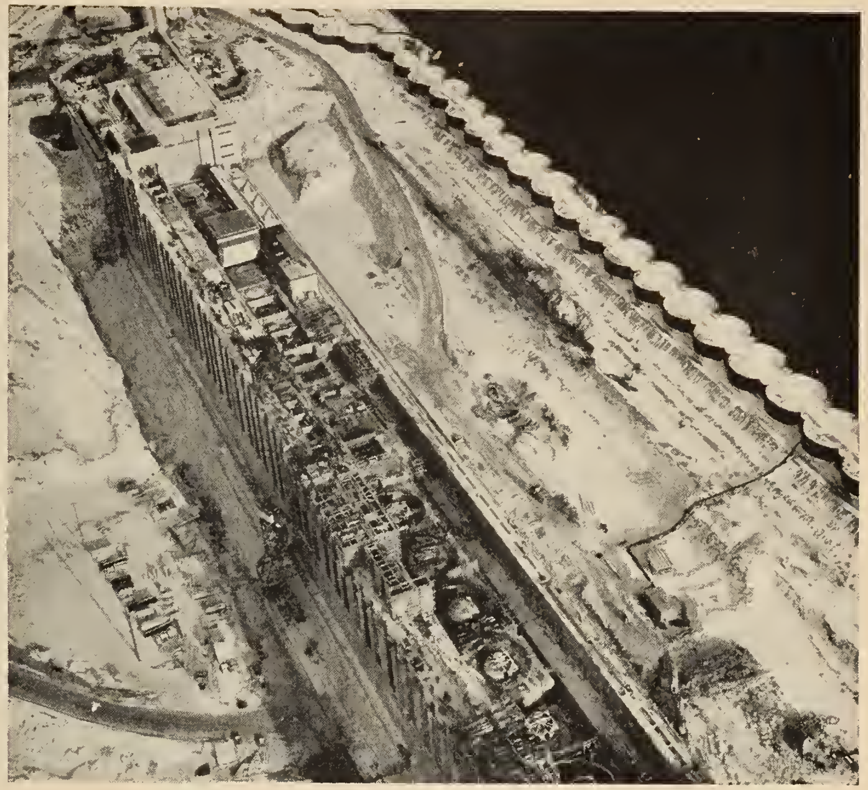
Rapid progress is being made also on the extensions to two existing plants on the Nipigon River. An additional unit at the Cameron Falls station is scheduled to be operating by the middle of 1958 and will increase the capacity of this plant to 76,700 kw. The new unit being installed at the nearby Alexander generating station is expected to be in operation early in 1958 to increase this station's capacity to 60,900 kw.

Meanwhile, an additional generator of 45,000-kw. capacity has been authorized for the Abitibi plant on the Abitibi River, 250 miles north of Sudbury, and installation was started in the Spring of 1958. Scheduled to be in service early in 1959, this unit will bring the capacity of the Abitibi station up to 226,000 kw.

In addition to generating stations in service or under construction in northern Ontario, power supply to this part of the Province is further protected through interconnections. The northeastern section has been connected with Hydro's Southern Ontario System since 1950. This tie is now being further strengtened by the construction of a new 230,000-volt line over a distance of 110 miles from the Commission's Otto Holden Station, on the Ottawa River, to Sudbury. Increasing power demands in the Blind River area necessitated the building of a similar type of line between that area and Sudbury. To meet the needs of the active uranium community of Elliot Lake, this line was placed in service in December 1957, at 115,000 volts until such time as a 230,000-volt transformer station is built at Blind River.

During 1957, Ontario Hydro also entered into an agreement with the Great Lakes Power Corporation at Sault Ste. Marie to deliver power over a line between the Commission's George W. Rayner station on the Mississagi River and Sault Ste. Marie, for a distance of 48 miles. Designed and engineered by Ontario Hydro, this line is being built by the Great Lakes Power Corporation.

With the idea of augmenting the output from its plants on the English River, the Commission completed a project during 1957 to connect the Root River with Lake St. Joseph. Construction forces succeeded in driving a 10,000-foot-long channel through



Seen here during the construction period is part of the Canadian half of the St. Lawrence power development, now known as the Robert H. Saunders — St. Lawrence generating station. Already partly in service, completion is due for 1960.

the difficult terrain of the northwestern Ontario forests to link this river and lake. The additional water from Lake St. Joseph has permitted the installation of the fifth unit at the Manitou Falls plant and has also influenced plans for the Caribou Falls station. At he same time, installation of larger capacity units will be possible when Hydro develops its Maynard Falls site on the English River. Generating stations on the Winnipeg River in the Province of Manitoba are also favourably affected by this unique undertaking.

Frequency Standardization

The Commission's program of frequency standardization, the largest of its kind ever undertaken, was launched in 1949 and involves changing over from 25 to 60-cycle operation a total of some 6,800,000 frequency-sensitive items for 1,014,000 customers. By the end of 1957 the program was approximately 90 per cent complete. The principal areas remaining to be standardized in southern Ontario include certain parts of Toronto and Leaside as well as a few communities to the southwest surrounding Burgessville, Embro and Cayuga.

A relatively small section in the northeastern part of the Province was to be changed over from 25 to 60 cycles, commencing in the Spring of 1958. With the completion of the program—in both the north and the south—by 1959, virtually the entire Province will be on the 60-cycle frequency which is more or less standard on the North American Continent. The uniform frequency will facilitate interconnections between Ontario and neighbouring provinces and also between Ontario and utilities in the United States.

Transmission Lines

A one-mile transmission test line of the extra-high voltage type is scheduled for completion early in 1959. During 1959 and 1960, studies of the transmission of electricity within a range of 260,000 to 600,000 volts will furnish data for the construction of two EHV lines, 250 miles long, in northeastern Ontario. Survey and location of these lines, to run between Sudbury and a point on the James Bay watershed, begins this fall with the first scheduled for service in late 1962. Ontario Hydro's long term planning calls for development of eight hydraulic sites with an estimated 1,000,000 kilowatts to be carried by these EHV lines.

MANITOBA

Power in Manitoba is generated and distributed through a three utility integrated system that was formed following recomendations made by the Provincial Government after submission of the Hogg Commission Report in 1948. The three utilities (The Manitoba Hydro-Electric Board, The Manitoba Power Commission, and The City of Winnipeg Hydro-Electric System) have clearly defined areas of responsibility and operate jointly in accordance with the terms of an agreement known as the Power Agreement.

The Manitoba Hydro-Electric Board is the primary generating authority in the group and is vested with the responsibility of ensuring an adequate supply of power to meet the Manitoba system requirements. It has a combined hydro and thermal turbine rated generating capacity of 763,000 h.p. Power from the Board generating stations is transmitted to Board owned terminal stations located in and close to the outskirts of Greater Winnipeg. From these points it is transmitted to either The Manitoba Power Commission or The City of Winnipeg Hydro-Electric System lines for distribution.

The City of Winnipeg Hydro-Electric System own and operate turbine rated generating equipment amounting to 273,000 h.p. Power from their generating stations is transmitted to and distributed within the City of Winnipeg on an exclusive franchise.

The Manitoba Power Commission services the rural areas of Manitoba and the suburbs and cities adjoining Winnipeg.

The Power Agreement is unique in many respects in that a new concept of the common bus was introduced which resulted in a simplification of both the sale and purchase of power between the three utilities. As generating stations constructed before the Second Great War had a much lower per-horsepower capital cost than those constructed after the war and those visualized to meet future requirements it was apparent that the cost of producing a kilowatt hour in the older stations would be much less than it would be from new stations. By using the pre-war developed generating capacity of The City of Winnipeg Hydro-Electric System as a basis The Manitoba Hydro-Electric Board alloted low capital cost generating Power Commission in ratio to the two distributing agencies' firm loads that existed at the time of the agreement. Power required from The

A view of the Amy Street steam-turbine generating station of the City of Winnipeg Hydro Electric System. This coal-fuelled plant produces over 68,000 h.p.

Manitoba Hydro-Electric Board in excess of the generating capacity of the City Hydro and the generating capacity allocated to the Power Commission is supplied from a Residual Pool. The Pool being the remaining available generating capacity of the Board. Both distributing utilities obtain power from this source at a higher cost as new stations have since been added to the system. The agreement has resulted in a very fair and equitable distribution of the cost of producing power in Manitoba and has contributed greatly in maintaining low rates in the province.

Another factor in holding energy costs down in Manitoba is the water heater control program inaugurated by The City Hydro in 1938 and accelerated during the war years to conserve badly needed electrical energy for more essential services The program has since been extended by the City Hydro and put into effect by the Power Commission in areas surrounding Winnipeg. It has resulted in probably the greatest number of remotely controlled water heaters in use in any city on the continent with an approximate load of 52 megawatts being controlled to conserve peak generating capacity for more profitable purposes.

The Manitoba power industry having faced the problem of hydro-steam integration or the development of northern hydro sites to supply the Southern power system decided in favor of hydro-steam integration until such time as it was economically advisable to develop the potential 4½ million horsepower available from the northern sites. The problem of thermal-hydro integration is not new to those producers who have exhausted their hydro resources and firmed their systems with steam. In Manitoba there is insufficient hydro installed capacity to meet winter peaks although providing river flows maintain average values the hydraulic generating stations are capable of meeting the load requirements for the greater part of the year. The Brandon generating station, a thermal station of 120-megawatt capacity will be completed this fall. The Selkirk generating station of the same capacity for the first stage of its development will be producing power in 1960. The Amy Street thermal station of the City Hydro of 51-megawatt capacity has been in operation for a number of years. The 315 megawatts from these thermal stations will be welded with the hydraulic present generating capacity of both the Board and City Hydro. The time is fast approaching when either through reduced river flows or increased firm load, the integration of hydro and thermal generated power will be of great importance to the overall cost of power in Manitoba. Continuing studies are being made to determine the best method of operation within the province and a joint study between The Manitoba Hydro-Electric Board and members of Ontario Hydro Electric Power Commission has been proposed towards fully integrating the resources of the northwest pool of Ontario Hydro and those of the Manitoba electrical industry.

The construction of the Kelsey Generating Station on the Nelson River in Northern Manitoba is well under way. This station will supply the International Nickel Company of Canada with an initial load of 102 megawatts and be capable of generating additional power should other industries be established in the adjacent area.

Permafrost exists in the majority of the overburden at the site and has created problems particularly in respect to working it with power equipment. In the summer when the thin layer of surface soil and timber is removed the permafrost areas are reduced to a semi-liquid state making it impractical to handle in a normal manner. Consequently excavation work where permafrost was known to exist was done during the winter months when it could be handled in its natural frozen state. Permafrost has been encountered during test drilling at most of the tower locations along the 58 mile transmission line route between Kelsey and Thompson. The construction of tower lines under these conditions will present many problems but the development of new methods has been and will be a necessary part of this project.

Interest in rural area electrification in Manitoba was intensified following the Farm Electrification Enquiry Commission of 1942 conducted by Messrs. Sanger, Schmidt and Caton in which the recommendation was made to the Provincial Government that a concerted effort be made to establish a test zone for farm electrification. The program was undertaken by The Manitoba Power Commission immediately following the war as materials and manpower became available with very satisfactory results. Approximately 8,500 farms were electrified annually until to-day ninety-three per cent of the farms in Manitoba are electrified.

In a province where the per capita use of power according to the Dominion Bureau of Statistics is fifty per cent higher than the national average it is essential that new generation and new distribution facilities be made available within economic limits to maintain a continuity of supply at the lowest possible price.

SASKATCHEWAN

Although Saskatchewan has considerable water-power resources within its borders, these resources are largely in the northern part of the province and far from the more heavily populated areas. Consequently, hydroelectric power has been developed mainly for mining purposes in the north, while thermal plants have been developed to serve the settled and industrial areas in the southern part of the province.

Large reserves of coal, oil, and natural gas are available in both Saskatchewan and the adjoining province of Alberta, and these fuels provide economic sources of thermal power.

Hydro-Electric Power

The main hydro-electric developments are: on at Island Falls, on the Churchill River, with a capacity of 106,500 h.p. (Churchill River Power Company); and the Consolidated Mining and Smelting Company plant at Wellington Lake, on the Charlot River, with an installed capacity of 3300 h.p., which is eventually to be doubled.

The largest development in the province, the South Saskatchewan River Dam, is discussed below.

The Hudson Bay Mining and Smelting Company has started construction of an additional 19,000 h.p. standby unit at the Island Falls plant. This should start operation early in 1959.

Thermal Power Development

Records of thermal power plants (over 1000 h.p. capacity) installed at the end of 1956 show that there were six main steam-turbine plants (fuelled by coal, oil, gas or a combination of these) with a combined capacity of 399,810 h.p.

At the same time there were ten diesel-powered plants with a total capacity of some 52,840 h.p.

Planned for installation in 1960 is an oil/gas-fuelled gas turbine unit of 21,450 h.p. capacity for the City of Regina. Apart from this unit, the major thermal power developments in the province planned and under construction since 1956 are within the operations of the Saskatchewan Power Corporation, the largest single supplier of power, whose transmission network covers a large part of the southern part of the province.

In 1957 the Corporation added a 40,220 h.p. (30,000 kw.) unit to the existing steam-turbine plant at Estevan, an 8000 kw. gas turbine unit to the new plant at Kindersley, and a 3000 kw. unit to the diesel plant at Swift Current.

Now under construction by the Corporation, and due to be completed by about 1959, are: a second gas turbine unit of 8000 kw. capacity at the Kindersley generating station; two 66,000 kw. units at the Boundary Dam steam plant, near Estevan; and two 66,000 kw. units at the South Saskatchewan River steam station, in Saskatoon.

Transmission and Distribution

Extensions to 72-kv. main transmission lines during 1957 totalled some 181 miles.

A 30,000 kva. substation was built at Estevan, and others totalling 22,500 kva. were completed at Fort Qu'Appelle, Ogema, Eston, Davidson, Prince Albert, North Battleford, and Unity.

During the same year, rural electric service was extended to an additional 6500 farms, making a total of about 46,500 farms in the province supplied with electrical power.

South Saskatchewan River Dam

A controversial project that has been studied for many years is the South Saskatchewan Dam. In July 1958 a federal-provincial agreement was signed which detailed the apportioning of costs and the division of responsibility for the approved project between the two governments.

Some details of the scheme were given in the September 1958 issue of *The Engineering Journal* (p. 105).

A main earth dam is to be built on the Saskatchewan River, between the towns of Elbow and Outlook, with an auxiliary earth dam in the Qu'Appelle Valley; and a large system of canals and pumping stations will eventually provide irrigation for 500,000 acres of soil. The work is under the supervision of the Prairie Farm Rehabilitation Administration, in Regina.

An addition to the water-control aspects of the project, a powerhouse is to be built at the site of the main dam. The installed capacity of this station will be determined when consideration has been given to the part it will play in the future plans of the province for an integrated thermal/hydro-electric system.

The potential of the project is estimated to be an average annual output of 475 million kwh., with 100 million kwh. of power for irrigation pumping.

ALBERTA

All four major energy sources—water power, natural gas, coal and oil—are used to produce electric power in Alberta. A pattern of use has evolved in which each energy source has taken its appropriate place in the generation of electricity. This assures

Alberta's industries of low and relatively stable power rates for the future, based on virtually unlimited sources of energy generally well located to serve major centres. In contrast, Eastern Canadian industry is faced with power costs that are likely to increase much faster as new plants are established in areas where low cost power resources are fully utilized.

Alberta's fuel resources exceed those of all the rest of Canada combined. They have played a major role in the economic development of the Province and, through export to other areas, promise to play an important part in the future development of Canada as a whole. While these resources have many applications in their primary form of coal, gas and oil, they become a much more versatile form of energy when converted into electricity. In this respect Alberta is well provided for, with an extensive network of transmission and distribution lines from the many generating plants to the industries, commercial establishments, residences and farms of the Province. Power for industrial needs is available in the areas adjacent to the main transmission lines at rates which compare favourably with other points in Canada.

Electric Power Facilities

Three privately-owned and three municipal corporations supply over 99 per cent of the electric power needs of the Province. The privately-owned corporation supplied 74 per cent of the total energy requirements in 1957. Of this total Calgary Power Ltd. supplied 65 per cent, Canadian Utilities Limited 8 per cent and Northland Utilities Limited 1 per cent. The municipal corporations supplied 26 per cent, with the City of Edmonton supplying 21 per cent, the City of Medicine Hat 3 per cent and the City of Lethbridge 2 per cent.

Power Generation in Alberta

Alberta is endowed with both hydro and fossil fuel resources within economic range of the principal load and population areas. An extensive network of high voltage transmission lines already links all the Province's major hydro and thermal power plants, and this makes possible the orderly and economic development of both sources of power as may be required to provide for the growing power needs.

To take advantage of cheap "peaking capacity" at existing hydro plants, extensions have been made or are under way which will at least double the present capacities.

The Wabamun thermal-electric plant of the Calgary Power Limited, which has two units of 66,000 kw. operating on natural gas, with provision for a coal-fuelled unit.

Principally on the Bow and Athabasca Rivers, there remains possibly several million kilowatts of potential peaking capacity within reach of the more thickly settled parts of Alberta. Plans are being prepared for the development of this hydro potential as and when required to keep the proportion of hydro peaking and base load thermal capacities such as will ensure the most economical future electric supply.

Though natural gas is currently in wide use in Alberta's thermal plants, it is a premium fuel because of its convenience for house heating and its value as a raw material in petrochemical plants. Futhermore, it can be economically transported by pipe line to distant markets where fuel costs are high. It would therefore appear only a matter of time before natural gas will price itself out as a fuel in base load thermal plants, particularly where low cost strip coal is available.

Alberta has large deposits of coal, and where these can be mined mechanically, the cost is low as compared to natural gas and it should be possible to maintain a high degree of price stability. This is particularly true in strip mines, but it also holds in highly mechanized underground operations. These coal reserves are therefore a major source of supply for the long term energy requirements of Alberta.

The Calgary Power Ltd. Steam plant on Lake Wabamun is a good example of the use of available fuels for base load generation. Assuming that gas would soon price itself out of the market as the cheapest means of providing its base load requirements, a site was chosen on Lake Wabamun, some 40 miles west of Edmonton, where there is ample cooling water and large reserves of cheap strip coal in close proximity. Although now fired with natural gas, the increase both in the price of gas and in the quantity required will soon make it economical to set up a strip mining operation as the main source of fuel.

Future Prospects

Looking to the future, and having regard to the rising cost of labour, the best hope of keeping down the cost of power lies in concentrating the production of energy in a few large steam plants adajacent to strip coal mines, and bringing in peaking and stand-by power from suitable hydro-electric developments.

Hydro-Electric Developments

The main hydro-electric power developments under construction or planned since 1956 are being carried out by Calgary Power Limited. In October 1957 a second unit of 23,000 h.p. was installed at the company's Cascades plant. To be used mainly for peak load purposes, the unit consists of a 23,000 h.p. Francis type turbine, under a head of 320 feet, connected to a 20,000 kva. generator.

Under construction are extensions to the Spray Lakes development which will approximately double the existing capacity. Scheduled for completion in October 1959 are: a second 62,000 h.p. unit at the Spray plant; and a 40,000 h.p. unit at the Rundle plant.

The company is continuing investigations of a possible development at the Big Bend site, on the Brazeau River. Investigations on the North Saskatchewan River at and near the Big Horn site were suspended when poor foundation conditions were revealed by exploratory drilling.

Steam-Electric Generation

Major additions to steam-turbine generating plants have been built or planned since 1956. Calgary Power Limited has added a second 66,000 kw. unit to the Wabamun plant, and has on order a third unit, of 150,000 kw., for completion in 1960. As mentioned earlier, this station exemplifies the changing trend in the use of fuels, since the second unit, now installed, operates on natural gas (as does the first unit), whereas the third unit will use coal as fuel.

The City of Edmonton is adding a further 66,000 kw. unit to the Edmonton steam plant, to be completed in 1960. This unit will use natural gas.

Gas Turbine Units

The gas turbine was first used in a Canadian central electric station in 1954 at the Vermilion plant of Canadian Utilities Limited. The same company has since constructed a 10,000 kw. gas turbine unit at the new Sturgeon plant near Valleyview in the Peace River district.

The City of Edmonton will shortly have added two 30,000 kw. gas turbine units at the Edmonton steam plant, and the City of Lethbridge has a new 7500 kw. gas turbine installation at the Lethbridge steam plant, with the proposed addition of a further unit of this type.

Another 7500 kw. gas turbine unit is in the Elk Point plant, at Two Hills, of Western Chemicals Limited.

The City of Medicine Hat has also proposed the addition of a gas turbine unit to existing facilities.

Oil and Gas Engine Plants

Canadian Utilities Limited and Northland Utilities Limited, in a joint operation, installed a new 3000 kw. gas engine generating unit in 1957 at the Fairview thermal plant. Northland Utilities also added a 1250 kw. gas engine unit at the Jasper thermal-electric station.

BRITISH COLUMBIA

The province of British Columbia ranks second in Canada in available resources, and is exceeded only by Quebec and Ontario in installed capacity.

During 1957 the total of 607,500 h.p. of new hydro-electric capacity installed was the highest among the provinces. A further 192,000 h.p. was under construction for 1958 operation, and considerable additional potential is being planned or in the early development stages for later service. The November issue of *The Engineering Journal*, which will mark the centenary of the province, will contain a more detailed article on the long-range planning of power development in British Columbia.

Kemano-Kitimat

The hydro power development at Kemano, in northern British Columbia, which supplies the Kitimat smelter of the Aluminum Company of Canada, was increased during 1957 to a total of 900,000 h.p. by the addition of a fifth and sixth generating unit. The seventh unit to be added will have a capacity of 150,000 h.p.

B.C. Power Commission

The B.C. Power Commission have estimated that in the next 10 years, the publicly owned utility's energy output must be quadrupled, from the present level of 1,000,000,000 kilowatts a year to a predicted load in 1967 of 4,000,000,000 kilowatts.

The Commission serves 212 communities in the province, the largest being Nanaimo on Vancouver Island with a population of 12,000.

Total installed capacity is 331,000 kw. Plants under construction will add a further 115,000 kw. in 1958 for a total of 446,000 kw. It is predicted that an additional 850,000 kw. will be needed in the area served by the Commission by the year 1970.

The Power Commission has 1,000 miles of transmission lines and 4,000 miles of distribution lines. During 1957, high-voltage transmission line interconnections included the 138,000 volt interconnection on Vancouver Island with the B.C. Electric's mainland system, and a 60,000 volt interconnection with the East Kootenay Power Co. for the Commission's Upper Columbia Valley system. Construction is also completed on the 138,000 volt interconnection between the Commission's Kamloops-Okanagan lines and those of the West Kootenay Power and Light Company.

New circuits from Ladore Falls to the John Hart station, and the third 138,000 volt line to the Dunsmuir station improved the supply and reliability of power on Vancouver Island.

During 1957, two major additions were made to the hydro capability. An initial 52,000 kw. was put into service at the Ladore Falls Plant in the Campbell River system of Vancouver Island. In the interior, a third unit with a capacity of 11,000 kw. was added to the Whatshan Hydro development on Lower Arrow Lake. Capacity increases were made at seven diesel electric stations at scattered points in the interior and the Commission completed and put into operation, three gas-diesel stations with a combined capacity of 30,000 kw. The gas diesel plants are located in the growing central interior centres of Quesnel, Dawson Creek, and Prince George, and operate on natural gas from B.C. wells.

The Commission became the first utility in B.C. to enter the gas turbine field when the first 20,000 kw. unit at the Georgia generating station, located at Chemainus on Vancouver Island, was put into operation in September 1957. With completion of the plant during 1958, it will have a capacity of 75,000 kw.

Some of the main hydro developments now under way are mentioned below.

Construction is under way at the powerhouse of the Upper Campbell Lake - Buttle Lake project, two miles below the outlet of Upper Campbell. Installation of the first 42,000 h.p. generating unit was completed during 1958.

Work on a project to divert water from the Heber River into Upper Campbell Lake, to provide additional water for the Upper Campbell development, will increase annual output of the total development by 40,000,000 kwh.

A recently completed diversion directs the Salmon River into the Lower Compbell to provide more water for power generation at Ladore Falls and John Hart developments. The project boosts annual output of the two plants by 100,000,000 kwh., and a Quinsam River diversion into Lower Campbell Lake increases the two plants' capacity even further — an additional 30,000,000 kwh. annually.

Vancouver Island needs the additional power these projects will provide. Though it has about 19% of the province's population, it is endowed with only 4% of the hydro potential. Because of this, the Commission is engaged in the first stage of a major source of hydro power in the Alberni valley. Several hydro developments on the Somass River system would enable 80,000 h.p. to be harnessed. The first step at Ash River is under construction. This plant will produce 35,000 h.p.

As another means of meeting the Island's future requirements, surveys are being made of the Homathko River with a view to bringing additional power from the Bute Inlet of the nearby mainland. There are several sites on the Homathko-Chilko systems capable together of producing to the order of 1,000,000 h.p.

B.C. Electric Company Limited

The British Columbia Electric Company Limited has had large hydro-electric developments in hand since 1956, but is also planning for major thermal power production.

The first two units of the company's Cheakamus hydro development came into operation late in 1957. Each unit consisted of a 95,000 h.p. turbine and 80,000 kva. generator. A 4000 h.p. two-unit installation at Clowhom Falls, on Sechelt Peninsula (bought in 1956 from B.C. Power Commission), was replaced in 1957 by a single-unit 40,000 h.p. turbine with 31,500 kva. generator. This involved raising the concrete gravity dam to a height of 71 feet.

At the company's Bridge River system, a 30,000 h.p. turbine and 24,500 kva. generator went into service late in 1957 at the La Joie dam power plant. Continuing work on the Bridge River development, for its final stages, involved a large storage dam on the River, a second tunnel through Mission Mountain, and a new powerhouse, Bridge River No. 2, on Seton Lake, about one-half mile upstream from the present plant. The effect of the storage dam is expected to increase the capacity of the four units in the existing plant from 248,000 h.p. to 276,000 h.p.

At the Bridge River No. 2 project, four units, each of an 82,000 h.p. turbine and 65,500 kva. generator, are due to be installed during the second half of 1959. This will provide a total plant capacity of 328,000 h.p.

In the thermal field, B.C. Electric started work in 1957 and has progressed with the construction of a gas turbine plant at Port Mann, consisting of four 32,500 h.p. turbines, each driving a 30,000 kva. generator. The units can operate on either oil or natural gas.

Looking further into the future, the company has made preliminary arrangements for a large steam plant at Ioco, on Burrard Inlet. This will have an ultimate capacity of over 1,200,000 h.p. from six units, each rated at 210,000 h.p. It is planned to put the first unit into operation in January 1961, the second in October 1961, and subsequent units as required.

In 1957 some 202 miles of 345 kv. transmission line were brought into service, and in 1958 a second line was added to the 138,000-volt cable linking the mainland with Vancouver Island. The story of this interesting engineering will be developed further in the November *Journal*.

Other Developments

The Consolidated Mining and Smelting Company of Canada Limited is investigating the second power site on the Pend d'Oreille River, about six miles upstream from its Waneta plant.

The Whitehorse Rapids project on the Yukon River, shown here during construction, comprises two 7500 h.p. units, with provision for further expansion.

In 1957 the Wenner-Gren Foundation, with the sanction of the B.C. government, started an investigation into the possibility of developing about 40,000 square miles in the far northern Rocky Mountain Trench. The general plan includes a possible 4,000,000 h.p. hydro-electric development on the Peace River. Surveys are to continue until the end of 1959.

YUKON AND N.W.T.

Yukon Territory water-power resources are relatively small, but it may be possible to divert the headwaters of the Yukon River through the coastal mountains to provide a high head for use in the northern part of the province.

Because of the remoteness of the areas and the lack of indigenous fuels, water power is very important to mining areas such as Yellowknife, N.W.T., and Mayo, Yukon Territory. Recent developments (in 1957) include a second 3000 h.p. hydro unit at Mayo River, and progress on the Whitehorse Rapids project (both in the Yukon). At the latter site two 7500 h.p. units are to be completed in 1958, with provision for a third.

Investigations have been made since 1954 by Northwest Power Industries Ltd. (subsidiary of Frobisher Ltd., and associated mining companies Ventures Ltd. and Quebec Metallurgical Industries Ltd.) into the possibilities of the Yukon-Aklin-Taku project which might ultimately provide some 5,000,000 h.p. for electro-chemical and metallurgical industries around Taku Inlet.

ACKNOWLEDGEMENTS

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Nuclear Power Development in Canada

M. H. Thomas

Atomic Energy of Canada Limited, Chalk River, Ontario

Although the development of power from nuclear energy on a large scale is still far from realization in most industrial countries, the subject is of the widest current interest. This article reviews the general subject, with particular reference to the thinking of engineers and conditions in this field in Canada.

Since the day in 1945 when the first atom bomb exploded over Hiroshima, the world has been aware of atomic energy, firstly through fear of the new military weapon and secondly through man's desire to harness this new form of energy to his own use. This second awareness is now becoming paramount since history clearly tells us that our advances in civilization have been directly related to our supplies of usable energy, whether slave, fossil fuel, or hydro-electric power. Atomic energy is a common subject for every day discussion; the newspapers and magazines are filled with stories telling of the wonders of the new source of energy. Our actual status today could probably be compared to the time the first electric generating plants in the 19th century attempted to light a town and run electric motors in a factory as far as our knowledge of nuclear power producing equipment and engineering is concerned. This is exemplified by recent reactor equipment failures in UK, USA, and Canada. These failures have been no more hazardous than those in the 19th century steam plants.

Historically, Canada became engaged in nuclear research during World War II. In 1942, after scientists, chiefly British and American, had made their governments aware of the possibility of a completely new weapon, "the atomic bomb", the first crude but successful nuclear reactor was operated in Chicago. Immediately a major program was started with the object of preparing a military weapon. Decisions were made which resulted in the United States, building and operating plutonium producing graphite reactors and uranium-235 producing gaseous diffusion plants, and a British-Canadian team undertook the building of a natural uranium-heavy water reactor for research and production complementing the major British and American efforts.

The concrete results of this wartime collaboration as far as Canada is concerned were twofold; firstly, two heavy water natural uranium reactors were built and, secondly, a team of highly trained scientists and engineers with well-equipped facilities was assembled due to the active role Canada assumed. This team has continued to make valuable contribution to the new technology through the experience gained in the successful operation of the two reactors. The two initial reactors built were: ZEEP with a very low power rating, the first built outside the United States, and used for experimental purposes particularly relating to fuel arrangements for experimental reactors (NRX, NRU), and latterly for power reactor designs; and NRX originally of 10 Mw. but later raised to 40 M. thermal power rating.

Operating initially in 1947, NRX was the world's first high flux reactor, and has been a useful research and development tool ever since. The primary objectives of NRX operation on which its original design was based were production of neutrons for various basic research programs, production of radioisotopes such as cobalt-60, and production of plutonium in the irradiated uranium fuel.

About 1950, it was becoming very apparent that the scientific and engineering development was progressing so rapidly that the application of nuclear energy on an industrial or commercial basis should be considered. Since that time, the primary objective of the Canadian program has been the development of economic nuclear power. Atomic Energy of Canada, a crown company, has endeavoured to provide facilities for the research and engineering work required, and to encourage Canadian industry to participate in the practical application in order to suit the particular Canadian requirements and economy.

Initially, NRX was re-adapted to engineering test programs for power fuels. Programming was delayed due to an accident in 1952, but work in this field in collaboration with Westinghouse Atomic Power Division led to the formation of a Nuclear Power Branch in 1954 which included industrial participation, the proposal of a power demonstration reactor, NPD, and a study on the feasibility of full-scale power reactors. Simultaneously, additional equipment to implement the program was built at Chalk River. Two new reactors became operative in 1957; a low power Pool Test Reactor primarily to be used for fuel evaluation and NRU, a 200 Mw. power high flux reactor. NRU will serve a triple purpose of a plutonium production reactor, radioisotope production reactor, and an experimental facility for high flux testing of fuels and engineering equipment. NRU became operational early in November. The construction of NPD has been undertaken, and will be completed by late 1961.

In March, 1958, a nuclear power plant division was set up by AECL in Toronto to extend the original feasibility study into an engineering development study of a proposed power reactor now called "Candu", and to approve the construction plans for the NPD reactor.

In a manner very similar to conventional steam plants but at present with several more variables, a number of different types of reactors are being considered by different countries. At the present time, all countries are working with uranium as the fuel for short-term programs. The actual fuel cycle is a nuclear one, but the heat removal problem is a conventional mechanical one. A brief description of the nuclear process will serve to highlight the variables.

Fission Process

Natural uranium metal which can be rolled and machined just like steel, contains one atom of U-235 in 140 atoms; 0.7% by weight, the balance being U-238 atoms—99.3%. Of these two isotopes, it is the U-235 isotope which takes part in a chain reaction. Thus, if we consider a rod of uranium say in the NRX reactor, the following possible sequence occurs. A neutron, which is a very small uncharged particle making up part of a nucleus of an atom approaches a U-235 nucleus, enters the nucleus, making it unstable. The nucleus is forced to seek a more stable condition and does so by splitting into two fragments called fission fragments or products. These two fragments, which are actually nuclei of lighter elements such as barium, strontium, etc. have a combined mass very slightly less than the mass of the original U-235 nucleus. It is the conversion of this mass to energy in accordance with the Einstein theory which gives rise to the so-called nuclear energy. The fission fragments fly apart with tremendous energies, but cannot move far as they are restrained by adjacent atoms. Hence, they slow down rapidly and in doing so give up their energy in the form of heat.

At the time of "splitting" or "fissioning" of the U-235 nucleus, something else happens. Two or three neutrons are ejected at very high velocities. These neutrons can potentially cause fissioning to take place in adjacent U-235 nuclei and this in fact is the way the chain reaction progresses. However, these very energetic neutrons are inefficient in causing fission to occur in U-235 nuclei and are much more effective when "slowed-down" to a point where they are called "thermal" neutrons. This slowing down or thermalizing is accomplished by allowing the fission neutrons to bounce around amongst the nuclei of light atoms such as hydrogen or carbon. Common materials used are water, graphite, and heavy water containing a heavy hydrogen isotope, deuterium. Heavy water is a much more effective moderator than graphite or water because of certain nuclear properties. Having bounced back and forth among heavy water nuclei, the neutron gradually loses most of its energy, becomes thermal and eventually is either captured in a U-238 nucleus, escapes to structural materials, or causes fission to occur in a U-235 nucleus to maintain the chain reaction.

A realization of the number of such events occurring simultaneously may be gained from considering that the neutron flux or intensity of, say the NRX reactor, is in excess of $10^{13}/cm^2$-/sec. That is to say ten million-million neutrons per second would pass through a thin window one quarter inch square if such a window were placed inside the "core" of the reactor.

There are a very large number of fission "events" occurring in each fraction of a second and the resulting energy release causes the uranium rod to get hot. This is the point in the process at which a real limitation exists. Were the power of the reactor not controlled, the heat output of the uranium would increase to the point that it could not be removed fast enough and the temperature would rise until the uranium melted. This is in fact what happened to some of the uranium fuel rods in the NRX reactor at the time of the major accident in 1952.

The extraction of this heat in an efficient manner is one of the problems which is being continuously investigated in the development of nuclear power reactors. At these rather high temperatures, uranium metal and most of the uranium alloys are severely corroded by the coolant which is forced over the surface of the fuel to carry away the heat. Hence, it is necessary to clad or sheath the fuel with a non-corroding material. For low temperature reactors such as the ones at Chalk River, aluminum is satisfactory. For higher temperatures which exist in the power reactor, aluminum does not have the required physical properties, and it is necessary to use such materials as stainless steel, zirconium, etc.

So, in general, reactors are characterized or typed—

(a) by the type of fuel used, natural uranium or alloys of fissionable elements (enriched reactors).

(b) by the kind of moderator used to slow down the neutrons.

(c) by the type of coolant used to extract the heat which primarily determines the steam conditions which can be attained.

Decisions on each characteristic has fundamental effects on the design criteria for a particular reactor—

The existing Canadian reactors at Chalk River are shown in Table I.

A number of countries have large supplies of uranium. In the free world, the estimated annual production for uranium oxide, U_3O_8, is about 30,000 tons per year in 1958. The leading producers are United States, Canada, and South Africa, with Canada producing about 14,000 tons per year. This uranium production is equivalent energy-wise potentially to 70 billion tons of coal per year. Reserves of economic ore are being increased rapidly. In addition, by the use of another nuclear process not described above, very high efficiency in the use of the fuel in the longer term stages of nuclear power development appears to be perfectly feasible.

A brief word should be said about the general program of various countries before discussing the Canadian program in greater detail. Generally, all countries in their initial programs are using natural uranium as the fuel, mostly as the metal. The major exception to this statement is the United States. Having had available gaseous

Table I. Canadian Nuclear Reactors at Chalk River

	Power (Thermal)	Fuel	Moderator	Coolant
ZEEP	up to 5 kw.	natural U	heavy water	heavy water (1)
NRX	to 40 kw.	natural U	heavy water	water
NRU	to 200 Mw.	natural U	heavy water	heavy water
PTR	to	enriched U	water	water (1)

(1) convection cooling only.

diffusion plants producing very highly enriched uranium-235 for military purposes, the United States has a two-way program on reactor development with regard to fuel and the chief emphasis has been placed on the use of U-235 enriched fuel in their general program.

Other Programs

From this point on, the programs of most major countries show considerable divergence based on their national requirements which may be illustrated by the few examples.

The United Kingdom plans to have in operation by 1965 nuclear plants producing five to six thousand Mw. electrical, equivalent to eighteen million tons of coal per year. For this first stage she is building advanced Calder Hall type stations. The nuclear reactors are natural uranium fuelled, graphite-moderated and CO_2-cooled, and represent Stage I of United Kingdom's move into the nuclear power field. They are expected to be competitive with thermal stations in England by 1962, and produce power at 6-8 mills in the English accounting system. Improvements announced in the last few months have increased the confidence in this type of reactor markedly and lowered the capital installation cost. Future stages will have reactors whose principles will be tested in small development reactors currently being constructed. The United Kingdom has a dire and urgent need for power, and wishes to reduce her imports to thirty million tons of coal per year.

Western Europe (Euratom) plans a target of 15,000 Mw. electrical by 1967, buying a portion of initial plant designs from countries with the engineering knowledge, chiefly United States and United Kingdom. They expect to buy a billion dollars worth of equipment from countries with the nuclear engineering facilities. France is the only country in this area with a highly developed nuclear technology, and is one of the "big" five in the nuclear field. Like the United Kingdom, the urge to turn to nuclear power is spurred on by a mounting coal and oil import cost as the area is no longer self sufficient in fossil fuel supply.

Scandinavia, which also imports considerable coal, is pressing a vigorous nuclear power development program concentrating on natural and enriched uranium reactors using heavy water moderators. Their program emphasis has been on ultimate use of the heat for process steam and space heat since considerable hydroelectric power development is still practical. Sweden for instance is planning a group of eight reactors for space heating in the Stockholm area.

Neither the United States nor the U.S.S.R. are in great need of nuclear power at the present time. The present forecasts are for 3,000-4,000 Mw. in U.S.A. by 1965 and 1500 Mw. in Russia by 1961. However, the United States has embarked on a three stage program of development reactors aimed chiefly at finding the economical types. As mentioned earlier, the United States program is largely based on the use of enriched fuel chiefly to keep the capital outlay per Mw.d. of power low and partly influenced by the capital accounting system. The most common forms of reactor in the U.S. program to date are pressurized water reactors and boiling water reactors using light water for both moderator and coolant. Recently two of the proposed reactors have been delayed or deleted because estimated costs were obviously rising very high and the proposals did not appear competitive.

Operating Prototypes

Five operating power plant prototypes are on stream in the Western World — Calder Hall (U.K.), two at Marcoule (France), EBWR and Shippingport (U.S.A.). Both Shippingport and Calder Hall are being scaled up to commercial units and show considerable promise. International competition for potential export markets is already beginning with several potential customers surveying the existing plants and evaluating their value with respect to their economics.

The Canadian situation as far as power demand is concerned may be summarized as follows: Canada has 49 thousand Mw. potential hydroelectric power of which, on Jan. 1, 1957, some 13.6 thousand Mw. had been developed. For 1955, 95.5% of our power consumed (69.5 million kwh.) was generated by water power and 4.5% (3.5 million kwh.) by thermal power. The result has been that Canadians have enjoyed one of the lowest rates per kilowatt hour in the world. Compared to the United States, the only other country exceeding Canada in amount of power generated, the rates (including transmission) to the consumer are as follows:

	Domestic	*Commercial*
U.S.	2.64 cents/kwh.	1.3
Canada	1.66	0.7

However, in certain sections of the country, our utilization of water power has been very high, particularly in Southern Ontario and the Maritime Provinces. Potentially, the Maritimes still have the possibility of water power from tides. Ontario has started to swing to thermal power already and the long range planning of the Hydro-Electric Commission indicates the lack of available hydropower.

Currently, Hydro-Electric Commission forecasts hydro usage remaining essentially static until 1980 at 5.5 thousand Mw., while thermo conventional advances to 10.6 thousand Mw. and nuclear thermal to 7.5 thousand Mw. by 1980.

Canadian Approach

With this brief background we can now consider the general Canadian approach. Although the Canadian effort is on a much smaller scale than a number of other countries, it has been successful and a significant contribution has been, and is being, made to the science and technology of nuclear power production. The Canadian authorities have reasoned that the Chalk River establishment should be primarily a research and development centre and that nuclear power plants should be operated by the utilities. Also, it has been established policy that as far as possible Canadian engineering firms should do reactor design and that Canadian manufacturers should fabricate the various reactor components.

To keep Canadian industry fully informed on the progress in the Canadian program, an Advisory Committee on Atomic Power was formed with representation from all the major Canadian utilities. This committee convenes as required and members are supplied with information which permits the evaluation of the economic importance of nuclear power in terms of their respective future power requirements. As a result of such an evaluation, the Ontario Hydro-Electric Power Commission joined Canadian General Electric and

Atomic Energy of Canada Limited in the Nuclear Power Demonstration project.

Construction of NPD was started about the middle of 1956 near the Des Joachims hydro electric station on the Ottawa river some 20 miles north west of the Chalk River project. The reactor will be Canada's first power producing unit, and will be a natural uranium fueled, heavy water moderated and cooled, reactor in keeping with Canada's experience at the Chalk River project. It is expected that the station will produce approximately 20Mw. of electricity which will be fed into the grid system of the Ontario Hydro Electric Power Commission.

Although construction started in mid-1956, a decision was made early in 1957 to reconsider some of the basic design features and construction was temporarily suspended. This change in plan resulted from data produced by the Nuclear Power group at Chalk River which has been assembling information for the technical assessment of a large power reactor program. The modified design is now essentially complete and construction was restarted in the fall of 1958, with the hope that power will be produced in 1961.

Long-Term Proposals

But what are Canada's longer term proposals for power development? Since 1954, a group of engineers have been working at Chalk River on power reactor feasibility studies. This group has been studying the feasibility of full scale nuclear power plants for central electric generating requirements. The general aim was to investigate the possibility of using such plant to supplant conventional fuel thermal plants since the country now must consider these to meet expanding power requirements. A report was issued in January, 1958, (AECL No. 557), in which it has been concluded that a natural uranium-heavy water nuclear plant of about 200Mw. electrical output could be designed and constructed to give power competitive with conventional fuel plants. The first two units built to such a concept would be more expensive but with the engineering developed on these units, future units would be competitive. It was estimated that units developed in such a program could become competitive with conventional thermal power plants within 10 years. The proposed units are estimated to cost $60 million dollars as capital investment, and to deliver power at less than 6 mills per kilowatt hour. On the basis of Ontario figures mentioned, if such plants were available, Ontario would save importing from the U.S.A. about 20 million tons of coal per year and would use instead uranium mined in Ontario.

This study was well received by the authorities in industry, government, and Atomic Energy of Canada. As a result, in March, 1958, a new AECL division, the Nuclear Power Plant Division, was formed with headquarters in Toronto with the responsibility of preparing an engineering development study of an approximately 200 Mw. electrical output reactor of the type recommended and of approving the work associated with the NPD reactor. (J. L. Gray, AECL No. 561). This division includes personnel contributed to this program by Ontario Hydro-electric Commission and industry.

Canadian Experience

It is not practical to attempt in this paper to present the various technological reasons for Canada's decision to forge ahead with the natural uranium-heavy water reactor concept. Due to our national viewpoint and with consideration of many factors, political, military, engineering capacity, etc., we have not built gaseous diffusion plants, and are bound in our initial program to uranium fuel. In Canada, we have had experience with high flux reactors in which the fuel was "burned-up" more completely; that is, greater heat output per ton of uranium was attained than in other types of thermal reactors. The feasibility study has justified our confidence in this approach. Since Canada produces a considerable quantity of natural uranium, it is naturally desirable for us to use our own fuel as economically prepared as possible. Theoretically, a ton of uranium has a heat potential of 20 billion kilowatt-hours or the equivalent of 2,600,000 tons of coal. At present, only a small fraction of the heat can be recovered since the fuel must be removed due to irradiation damage and the accumulation of fission products or "ashes" of the fission reaction. The study of ways and means to lengthen this fuel life has been one of the important developments in the Canadian program. The use of uranium oxide instead of metal assists materially in this problem and our first power reactors will probably use uranium oxide fuel.

Canada's experience with heavy water as moderator in NRX has led her to apply heavy water for both fuel coolant and moderator in NRU. Although the heavy water is expensive at $28 per pound, its use is justified in savings in capital expenditures, fuel inventory, etc. The use of heavy water improves the neutron economy and the power density in the fuel.

The studies made so far in Canada are on central electric generating stations, effectively base load plants. These studies indicate the size must be about 200 Mwe. to be economic at this time. This size will be competitive with conventional fuel thermal stations in Canada. It may be possible to lower this size or improve its costs as operating and engineering experience is gained. For other types of power generation such as ships, enriched fuel reactors are indicated since these can be built in very much smaller space requirements. Small reactors capable of 25 Mwe. capacity, say, are estimated by U.S. studies as producing power at more than 15 mill kwh. To date, Canada has made little effort to study small plant designs since the power costs are expensive and enriched fuel appears necessary. Both United States and United Kingdom are developing reactors in this field primarily for ship propulsion and military use.

Engineers and scientists at Chalk River are very optimistic about the future of nuclear power, but a tremendous amount of engineering development work still remains to be done. However, now that actual power units are being built or studied in detail, more rapid progress should be made.

SUMMARY

In summary, we can say Canada has a small well-equipped team of scientists and engineers actively engaged in the field on nuclear power development. Their work and study are directed primarily at economic basis load stations designed to meet our particular needs and applying Canadian raw material as fuel. Simultaneously, she is trying to develop in Canadian industry the necessary know-how to build such nuclear equipment as is required and to give industry the knowledge of how and where to use nuclear power.

International Passamaquoddy Tidal Power Project

G. Millar

Chief Engineer, Harbours and Rivers Engineering Branch, Department of Public Works of Canada

The economic feasability of developing large scale tidal power in Passamaquoddy Bay is being investigated jointly by the United States and Canada at an estimated cost of $3,300,000. The investigations will consist of a comprehensive survey of every phase of the proposed project, and will include any possible effect on the fisheries in the area. A two-pool arrangement has been adopted for purposes of design whereby continuous power will be generated at a capacity varying between 100,000 and 375,000 kilowatts, having an annual energy output of approximately 1,800,000,000 kilowatt hours. It is expected that these investigations will be completed by the fall of 1959.

ON THE EAST coast of North America, lying between Canada and the United States, is Passamaquoddy Bay. As part of the Bay of Fundy, Passamaquoddy is affected by the high tides which course up and down between the Provinces of Nova Scotia and New Brunswick (Fig. 1).

The derivation of the name "Passamaquoddy" indicates one of the major problems to be considered in connection with the development of tidal power at this location. Derived from the Indian word "peskutumaquahdic" meaning "the place where the fish are", the name Passamaquoddy refers to a large body of water where there are some important Canadian and United States fisheries.

Tidal power has been a dream of men for many years, and many schemes have been proposed for the development of such power. At the present time, a project for the development of the tides is under way at the River Rance in France. Other schemes for the development of tides have been proposed for San Jose in Argentina, the Severn River in England, and for Mont Saint Michel in France.

In addition to the Passamaquoddy project, investigations have been carried out for another proposed development in the Bay of Fundy. The Memramcook and Petitcodiac estuaries in the upper reaches of the Bay have been the subject of a tidal power investigation by consulting engineers employed by the Government of Canada.

The first serious proposal for a tidal power development, using the waters and the tides in Passamaquoddy, was proposed by Dexter P. Cooper, a distinguished Canadian hydraulic engineer, in the early 1920's.

The original Cooper plan was based upon the use of two bays; Cobscook Bay, located wholly within the United States, and Passamaquoddy Bay, partly within both the United States and Canada. Power was to be generated by drawing water through turbines located between the two pools at Carrying Place Cove on Moose Island near Eastport. Cobscook Bay was to be closed by a series of barriers extending between Lubec, Dudley and Treat Islands, and Eastport. Dams between Moose Island, Eastport and the United States mainland were to separate Cobscook and Passamaquoddy Bays. Passamaquoddy Bay was to be closed by a dam between Eastport and Deer Island and a series of dams between Deer Island and the Canadian mainland in the Letite Passage area. Each bay was to have appropriate filling or emptying gates and ship locks to facilitate navigation.

In 1924, Cooper filed an application with the United States Federal Power Commission for a preliminary permit for his two-pool international tidal power development. Charters were secured from the State of Maine in 1925 and from the Province of New Brunswick in 1928, and an application for project license was filed with the United States Federal Power Commission in 1929. With the advent of the depression, Cooper was unable to secure continuing financial backing to undertake construction.

In 1935, as a relief project, the Government of the United States took over the proposal to develop a tidal project using only the waters of the Bays on the American side of the international boundary. This work was suspended in 1936 before any major construction works could be undertaken. Although the project was not completed, the surveys, investigations and the work completed by the Corps of Engineers is of great value for the present investigation.

The people of Maine and New Brunswick have been continuously interested in this great project, and in 1948, as a result of this interest, the Governments of the United States and Canada instructed the International Joint Commission to review the various reports that had already been made on the Passamaquoddy tidal project, and to make an estimate of cost of carrying out a complete study which would determine the engineering and economic feasibility of this development. In 1950, the International Joint Commission reported to the two Governments that the investigation, required to determine the practicability of the project, would cost approximately $3,900,000.

It was not until 1956 that the two Governments requested the International Joint Commission to undertake this extensive study.

This investigation has been broken down into two parts. An investigation into the engineering aspects of the work and an investigation into the possible effects that the proposed works would have on the fisheries in the area. In order to carry out these two separate studies, the International Joint Commission established two boards, one consisting of engineers and the second consisting of fisheries experts. This paper deals mainly with the studies being carried out by the International Passamaquoddy Engineering Board.

In general, the investigations consist of a comprehensive survey of every phase of the project in sufficient detail to determine the type and cost of the most economical structures necessary to convert the enormous power of the tides into electrical energy.

The International Passamaquoddy Engineering Board, which has been delegated with the responsibility of carrying out the feasibility and economic studies, consists of two representatives of the Government of the United States and two representatives of the Government of Canada. The work in Canada is under the direction of the Harbours and Rivers Engineering Branch of the Department of Public works and in the United States under the Corps of Engineers, Department of the United States Army. Associated with this work in Canada is the Water Resources Branch of the Department of Northern Affairs and National Resources, and in the United States, the Federal Power Commission.

GENERAL FEATURES

The project area includes Passamaquoddy and Cobscook Bays, with a total area of approximately 140 square miles. These bays are partially separated from the Bay of Fundy by numerous islands, including the large islands of Deer and Campobello. Cobscook Bay has an area of 38 square miles, all of which lies south of the international boundary. The area of Passamaquoddy Bay is 103 square miles, of which 87 square miles are in Canada, and 16 are in the United States. (Fig. 2.)

The waters of these two bays rise and fall with the Bay of Fundy tides. The tide range varies from day to day, with a maximum of 27 feet, a minimum of 15 feet, and an average range of approximately 19 feet. During each high tide cycle, a volume of about 3,800 square-mile-feet, or 100 billion cubic feet of water regularly enters and leaves the two bays at an average rate of over 5,000,000 cubic feet per second. The depth of water, the high turbulence, and fast currents, as well as the uncertain foundation conditions add to the difficulty facing this project.

There are two basic schemes for the development of large scale tidal power. They are the one-pool and the two-pool schemes and each has advantages and disadvantages.

The one-pool scheme[1] is simplest in design. It consists of a single barrier or dam containing the power units, gates and locks separating the bay or basin from the ocean. There are three variations of the one-pool scheme.

(1) The single effect: power is generated, from basin to sea during part of the falling tide.

(2) The double effect: power is generated during the falling tide from basin to sea as well as during the rising tide from sea to basin. This is possible by the use of reversible pitch propellor blades or by gate arrangements.

(3) The double effect with pumping: an additional pumping feature minimizes the shutdown period and increases the range within the basin.

The advantage of the one-pool proposal is the economy to be gained by a minimum number of structural components. Its major disadvantage is the discontinuity and variation of the power output.

The two-pool scheme consists of three barriers or dams: one separating the high pool from the sea and containing the filling gates; one separating the low pool from the sea and containing the emptying gates, and a third dam separating the high pool from the low pool and containing the powerhouse.

The operation of the two-pool scheme is simple. The upper pool filling gates are opened only during times when the ocean level is higher than the upper pool and the emptying gates of the lower pool are opened only when the ocean level is lower than the lower pool. The sequence of operations would be:

(1) The filling gates are closed soon after high tide when the inflow ceases and the level in the upper pool is the same as the level in the ocean. At this stage the upper pool is at its maximum elevation. The emptying gates have been closed for some time and the powerhouse has been discharging into the lower pool.

(2) The emptying gates are opened when the level of the falling tide and the level of the lower pool become the same. At this stage the lower pool is at its highest elevation.

(3) The emptying gates are closed soon after low tide when the outflow ceases and the level of the lower pool is the same as the level in the ocean. At this stage the lower pool is at its minimum elevation.

(4) Both gates remain closed as the tide continues to rise until the elevation of the upper pool, which has been falling, and the elevation of the sea, which has been rising, becomes the same, and then the filling gates are opened. At this stage the upper pool is at its lowest elevation.

(5) The filling gates remain opened until soon after high tide when the inflow ceases and they are closed, completing the cycle.

The head on the turbine is the difference in elevation between the upper and lower pools and there are two maximums and two minimums during a single tidal cycle. The maximum heads occur at high tide and at low tide and the minimum heads occur soon after mean sea level is reached on both the rising and falling tides. (Fig. 3).

The advantage of the two-pool development is the continuous output of power. Its major disadvantage is the additional structure components required and lower energy output.

INVESTIGATIONS

In the initial phase of the study the two-pool scheme was selected as being preferable for the Passamaquoddy development. After considering the sociological as well as the engineering and political factors, Passamaquoddy Bay was selected to be the high pool and Cobscook Bay to be the low pool.

Some of the important engineering

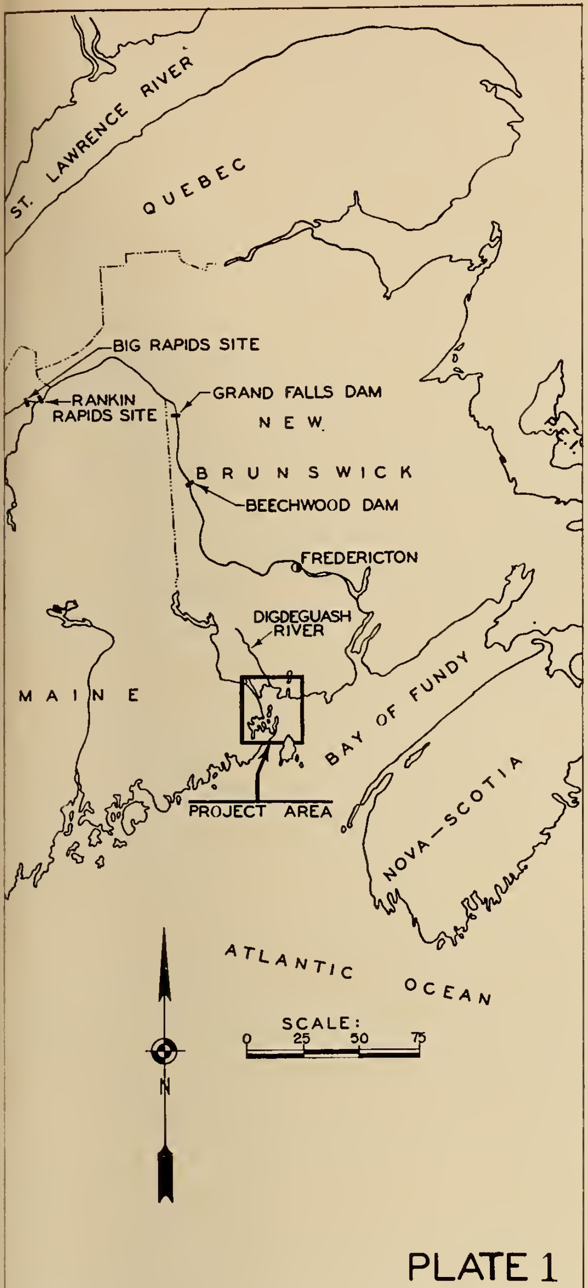


Fig. 1. A general map of the area of the Bay of Fundy, between New Brunswick and Nova Scotia, showing the region in which the proposed power project might operate.

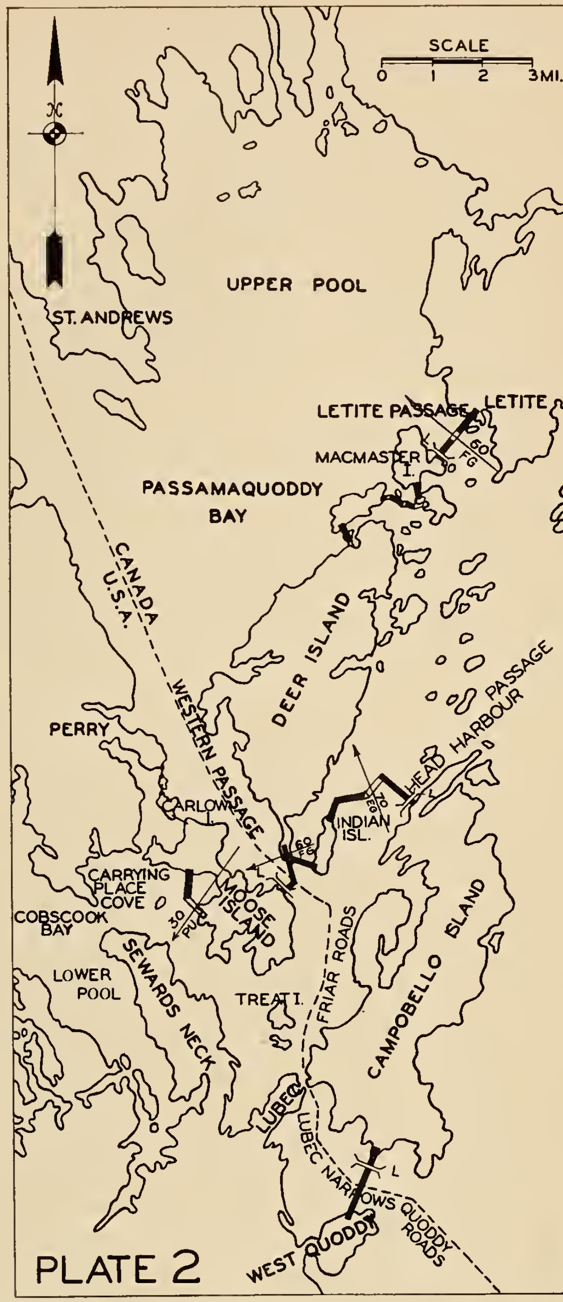


Fig. 2. Detail of the project area, with particular reference to Passamaquoddy Bay and the adjacent islands. Of the Bay, about 84.5% is in Canada, the rest in the U.S.A.

investigations and studies undertaken include the following:

(a) Project Layout Studies: Sixty different general arrangement schemes were reviewed and comparative cost and power estimates were developed. Five of these were given detailed study and from this group two were selected for submission to the International Joint Commission for approval. The project layout approved by the International Joint Commission for further study is shown on Fig. 2.

The features of this layout include: (i) over 7 miles of dams; (ii) a 30-unit powerhouse at Carrying Place Cove; (iii) 50 filling gates at Letite Passage dam; (iv) a navigation lock in the Letite Passage dam; (v) 60 filling gates at the Dog's Island–Deer Point dam; (vi) a lock at the Dog's Island–Deer Point dam; (vii) 70 emptying gates located between Indian Island and Pope's Island; (viii) a lock located at the Head Harbour Passage dam; and (ix) a lock located at the Quoddy Roads dam.

The generator capacity with this proposed arrangement would vary from 100,000 kw. during neap tides to 375,000 kw. during high tides and the annual energy output would be approximately 1,820,000,000 kwh.

(b) Studies to Determine Optimum Number of Turbines and Emptying and Filling Gates: The study and calculations for the determination of the optimum selection and arrangement of power units and gates involves a tedious procedure of multiple trial runs. The estimation of the output of the project is complicated by the fluctuation of the levels of the two pools due to variations in the tide range and the rate of flow from the high to the low pool. The greater the capacity of the turbine-generator units that are assumed in operation the greater will be the rate of rise of the lower pool and the rate of fall of the upper pool.

The cost of adding incremental power generating units must be weighted against the extra power generated by adding these units. At some particular number of generating units, according to their size, there will be diminishing returns. The optimum size and number of generating units must be determined. This is also true for the filling and emptying gates. There were many combinations of the number of generating units, number of emptying gates, and number of filling gates to be studied and related to cost and benefit.

Through the use of electronic computors results were obtained in a much shorter time than would have been possible otherwise. The results or answers obtained with the computors were related to the costs of the different type of structural components, and a selection of the most favourable and economical combination of units and gates for the project was made. (Fig. 2).

(c) Turbine and Generator Study: The study on turbines and generators is to determine the size and type best suited to the unusual conditions of low and rapidly changing head prevailing at the project. Dexter P. Cooper, in his plans, included an initial installation of 20 fixed-blade propellor type units, throat diameter 320 inches, 40 r.p.m., at a spacing of 65 feet; with an ultimate installation of 44 units. The proposed generator capacity was 16,667 kva. at a head of 23 feet.

During the course of its 1935-36 studies, the Corps of Engineers, United States Army, received from turbine manufacturers, proposals for 320-inch, 40 r.p.m., fixed-blade propellor turbines. The manufacturers recommended a unit spacing of 95 to 105 feet. However, preliminary Corps' studies at that time indicated 80-foot spacings to be a reasonable minimum. Because unit spacing is a major factor in the cost of the powerhouse, model studies were carried out. The report on the various tests is quoted in part as follows:

". . . It was soon apparent that the narrow unit spacing was having no serious effect upon the performance and at three laboratories tests were made at a spacing equal to 70 feet. These tests showed that the further reduction in width to 60 feet had a slight effect upon the performance, but in two cases the impairment was unimportant . . ."

". . . As a result of these tests it was found that the width of the water passage and the unit spacing could be materially reduced without affecting the turbine performance and that the depth of excavation had a greater effect upon the performance than did the width of the water passage. In general it was established that a deeper draft tube was necessary with a narrow unit setting and a width of water passage equal to 65 feet clear opening was found satisfactory . . ."

The current studies were initiated by reviewing the findings of the 1935 investigations. It was considered that the most economical powerhouse design would result from the use of the largest practical turbine size. Preliminary discussions with the various manufacturers and others indicate that a 320-inch turbine is about as large as can be conveniently manufactured. Because the cost of generating equipment would increase rapidly for lower speeds, a speed of 40 r.p.m. is considered to be most economical. The excavation costs for the longer powerhouse would increase with smaller units at higher speeds.

Performance curves were obtained for 320-inch, 40 r.p.m. Kaplan and fixed-blade turbines in their standard settings from various manufacturers.

Studies showed that to equip each unit with individual wicket gates and governors, and install a travelling gantry to insert or remove emergency stop-logs was more economical than to equip each unit with individual head and tail gates.

The cost of the wicket gates and governors increases the total cost of each unit, but this cost is offset by the saving in cost of providing only sufficient stop-logs for a nominal number of units. This arrangement would result in greater flexibility of operation and increased efficiency with a minimum of labour.

Preliminary investigations and studies have been made of the European bulb - type generator - turbine - pump unit as proposed for the Rance project in France, the sloping-axis unit, and gear-drive connections between the turbine and generator. Sufficient detailed data concerning the performance of these alternate possibilities is not available as yet to permit any satisfactory conclusion. Consequently, for the purposes of the feasibility survey, further consideration has been discontinued until more factual information is available.

For the purposes of the present investigation the following basic assumptions have been made:

(a) The turbine diameter to be 320 inches.

(b) Operating speed to be 40 r.p.m.

(c) The turbines to be fixed-blade type with blades at the angle of best efficiency.

(d) Each turbine to be provided with governor operated wicket gates.

(e) The turbine to be set vertically in a powerhouse unit having a gross water passage width of 65 feet and the draft tube to extend 73.5 feet below the centre line of the distributor.

(f) The generator capacity to be a minimum of 10,000 kilowatts.

(d) Filling and Emptying Gate Study: The purpose of this study is the determination of the best type of gate for the efficient filling and emptying of the two pools. The problems are the same for the emptying gates as for the filling gates and the study applies to both, except that the emptying gates must be at a lower elevation. Studies were carried out by Cooper and by the Corps of Engineers in 1935. The present investigation includes a review of these earlier studies.

Dexter P. Cooper selected a 30 x 30 foot vertical lift type of gate. The structure housing the gate had a curved-shaped roof entrance and a uniformly expanding discharge section to reduce head losses and to regain velocity head. This was designated as a "Venturi" gate. Model studies carried out by Cooper indicated a possibility of reducing the length of the Venturi roof without appreciably reducing the discharge coefficient.

Model tests carried out by the Corps of Engineers in 1935 indicated a significant improvement in capacity with the Venturi roof removed completely and further tests were made on this basis.

Extensive model studies conducted at the Worcester Polytechnic Institute in connection with the 1935-36 construction program of the single effect single pool project, showed that the crest type of structure can pass more water than the submerged Venturi type for the same width and bottom elevation. This advantage, however, was offset by the several constructional and operational factors, such as higher head frames for the higher gates, increased operating cost, increased maintenance costs due to icing conditions and increased possibility of malfunctioning of the units due to freezing, and interference from floating debris and ice.

The present gate studies do not include further model tests as sufficient data are available from the previous tests. The studies indicate that, using the available test data, the relative capacity of any type of gate can be estimated to within 10 per cent. Further model studies will, however, be required if the project is authorized for construction.

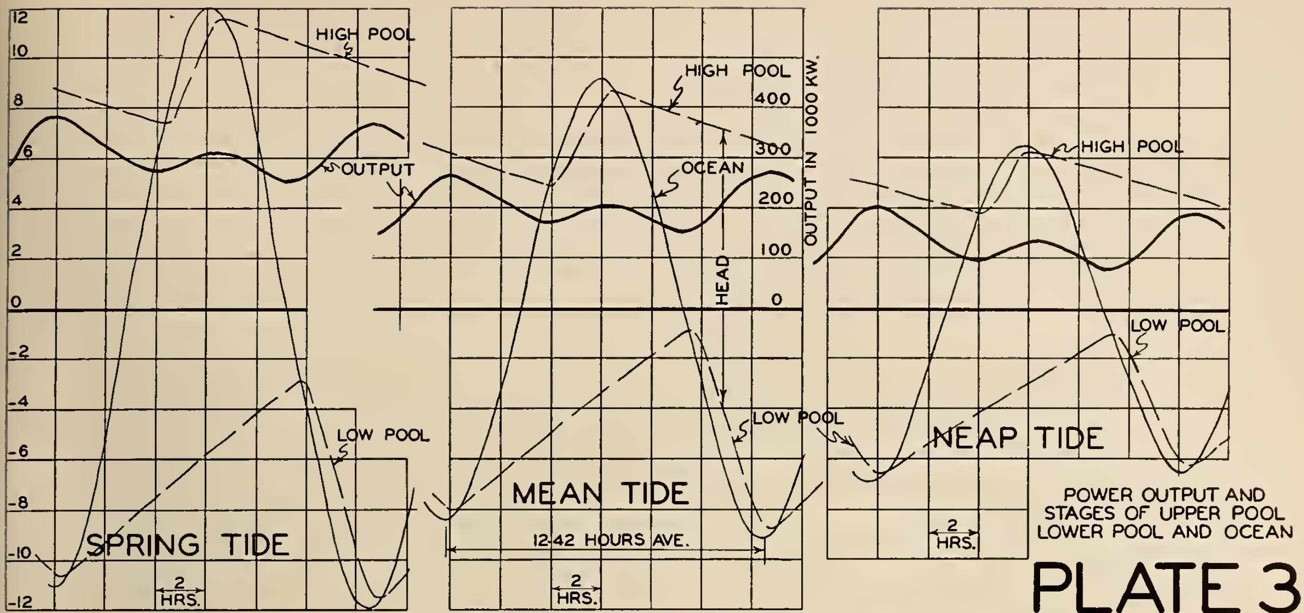


Fig. 3. Variation of tides at different seasons, indicating the resulting power output under the various probable stages of level of upper and lower pools and the ocean.

The power output computations carried out to determine the project layout, and number of generators and gates were based on the assumption that the gate operations would be instantaneous. In actual practice this is not possible. If the time required to close the filling gates is 25 minutes in duration, in this interval the upper pool would be lowered by one-tenth of a foot. This amount would be insignificant for river plants, but it represents nearly one per cent of the average head for the tidal project, and would result in an annual loss of 12 million kilowatt hours. The corresponding loss resulting from the same time of closing for the emptying gates would be about 8 million kwh, a total loss of 20 million kwh. for the both operations. A 5-minute gate operating period is considered to be the maximum. This would reduce the energy loss to one-seventh without a significant increase in the machinery cost.

The minimum head on the turbine occurs at the same time that the gates must be opened. It is, therefore, important that the power required to operate the gates should be kept to a minimum so that the project power output will not be further penalized at the critical time. Because of the need for operating a large number of gates within a short interval of time, individual operating machinery for each gate will be necessary.

Each of the 160 gates would open and close with each tide, and in one year there are 706 tidal cycles, so that each gate would be operated 1,412 times. The total number of operations for all the gates in one year would be 225,920. With this large number of operations it is possible that several malfunctions in gate operations would be encountered each year, and would result in loss of output. If one filling gate was not operating and remained in the open position for one tide cycle of 12.4 hours the loss would be 49,000 kwh., or in closed position for the same time the loss would be 3,500 kwh. Similarly, if one emptying gate was not operating and remained in the open position for one tidal cycle, the loss would be 80,000 kwh., and 3,300 kwh. in the closed position. These losses are relatively small and, therefore, facilities for emergency remedial action should not exceed the value of energy loss. For all gates the greater loss of energy occurs when they are stuck in the opened position. In the construction of the dam each sluice will be provided with bulkhead slots or gains on each side of the service gate slot, and a minimum number of stoplogs or gate leaves will be required for any emergency closure.

In the project area wind-driven spray can form heavy coatings of ice on that part of the structures above the water line. Studies of records of daily air and water temperatures, wind vectors, and 'on-the-spot' investigations, indicate that the type of gate to be used should be such that the danger of malfunctioning due to icing should be a minimum.

Research and study on the use of wood and steel gates under salt water conditions are being carried out. The use of metals having a reasonable degree of inherent corrosion resistance is not economic, and dependence must be placed upon protective measures such as frequent painting as well as cathodic protection, or the use of treated timber in lieu of steel. Other factors to be considered in the selection of suitable material for gates, are marine borers, fungus, barnacles, and other incrustations.

If steel gates are used, painting will be required every two or three years, as well as some type of cathodic protection. The fungus and borer problem would not exist and an anti-fouling compound to protect against the barnacles could be included in the topside paint coating.

If properly treated timber gates are used, a useful life of at least twenty years can be expected. The fungus and borer problem would be minimized, but the barnacles would have to be scraped off periodically. Damage due to debris jamming against the wooden gates would be greater than for steel.

Preliminary investigations have been carried out on the various possible types of gates. For the submerged setting, the vertical lift, the wicket, the mitre and the sliding gates were considered. For the open crest setting the studies included the vertical lift, the wicket, the taintor, the drum, the roller, and the flap types. As a result of these studies on the different types, the vertical lift gate in both the submerged and crest settings, and the wicket gate in the submerged setting were selected for further study.

(e) Auxilliary Power Study: The purpose of the auxilliary power study is to determine the capacity, type and location of other sources of power which will be required to firm up the tidal plant output to satisfy a given load requirement.

Although the energy produced from a two-pool tidal plant is referred to as being continuous, it varies greatly between minimum and maximum limits and is not adaptable to significant regulation. The tidal plant output, assuming no turbine regulation, would be at a maximum or minimum at the same relative position on each tidal cycle. These maxima and minima will be repeated every 12.42 hours but will be increased or decreased depending on the amplitude change of each successive tide. The energy cycle is, therefore, advanced by about 25 minutes every tidal cycle. The load cycle remains constant related to time, but the maximum and minimum will depend on the weekly, daily, and hourly needs of the customers. Therefore, a given load condition will occur with equal probability on all phases of the tidal plant output, and at times the tidal plant output will not be sufficient to supply a given load while at other times it will exceed the load.

Tidal plant energy output is closely predictable because of the predictability of tides. Some regulation within a tidal cycle can be made to meet some load conditions, but not without considerable loss in total energy. With a fixed optimum number of generating units and gates, any temporary pondage or savings of load will be eliminated unless utilized before the next gate operation. It is, therefore, indicated that operating for maximum energy is the optimum method of operation for the tidal plant and that its output should be integrated with some other dependable and flexible source of power so that a given load can be supplied at all times by the combined output of the tidal plant and the auxiliary plant.

The tidal plant output will increase and decrease between certain low limits during neap tides and between certain higher limits during high tides so that at no time will the output be constant. The auxiliary power plant will be required to supply the difference between the varying load and the varying tidal plant output. During high tides the required output from the auxiliary plant will be a minimum and during low tide will be a maximum.

If the auxiliary power is provided by a river hydro-plant, the pondage requirements will differ from that required for normal river operation, and some storage might be required to provide downstream regulations to maintain reasonable water levels.

The tidal plant without auxiliary capacity is only feasible if the variable tidal output, or a great percentage of it, can be utilized directly as generated by such industries as metallurgical reduction processes having a high degree of automation, where the rate of production can be made a function of the tide.

Studies are being made to evaluate the economic feasibility of the following combinations as well as the tidal plant without any auxiliary: (1) the tidal plant with a pumped storage as an auxiliary; (2) the tidal plant with a river hydro-plant as an auxiliary, and (3) the tidal plant with a steam generating plant as an auxiliary.

(f) Topographic Survey: Topographical information of areas not previously mapped, and additional information of the immediate project areas was required for project planning. The required aerial and ground work has been completed of all areas at the tidal project site; the Digdequash River Basin, which is being investigated as a pumped-storage site; and the Upper Saint John River Basin, which is being investigated for auxiliary hydro sites.

The information obtained from these surveys is required to determine storage capacities of reservoirs, location of structures, and areas of land to be flooded.

(g) Fathometric Survey: This survey was carried out to obtain subaqueous contours of the tops of the overburden, the top of the bedrock and information regarding the stratification of the overburden. The work was carried out employing a method similar to echo sounding for depth determination, and a method similar to Shoran for boat positioning.

The sounding equipment was carried in a 30-foot boat and consisted of a transmitter and receiver capable of emitting high-frequency waves that could penetrate through the overburden, be reflected at the various surfaces of the layers of the overburden and the bedrock, and recorded as reflected impulses on a time graph.

The electronic positioning equipment consisted of a mobile master transmitting and receiving station located in the sounding boat, and a number of fixed beacons or slave transmitting and receiving stations located at known positions on shore. The transmitters and receivers of the master and slave stations were tuned to the same operating frequencies. At the master station the time required for the impulse to go to a slave station and return was measured. From the known frequency and wavelength of the impulse, measured time could be converted to units of length. The positioning equipment used in this survey had a maximum range of 50 miles and an accuracy within 20 feet.

After the soundings have been reduced to mean sea level, contour maps will be produced to show the required details.

(h) Underwater Investigation: To obtain core samples of the overburden materials for foundation study purposes, and to aid in the interpretation of records from the fathometric survey, it was necessary to carry out drilling in deep water. Fourteen holes were drilled, two in depths of water exceeding 225 feet; three in depths between 150 and 225 feet, and nine in depths of water less than 100 feet. In each case the drill penetrated through the overburden and into the bedrock.

Undisturbed core samples were obtained for the entire depth of each drill hole. A specially constructed drill boat equipped with an oil-drilling derrick mounted over a well was used. (This boat and its equipment were previously employed in drilling in the Gulf of Mexico for oil companies.) The boat was held stationary over the drill spot with four anchors attached to long heavy cables which required constant adjustment to compensate for the changing tide stage, fast currents, and heavy turbulence.

A guide pipe, 12 in. diam. and in 75-foot sections, was secured to the boat with cables. Three of the 75-foot sections were required for the drilling of the two holes in deep water. Two sections were used where the depth of water was between 150 and 225 feet, and one section only was required where the depth of water was less than 100 feet.

A drill casing consisting of various lengths of pipe was then coupled and inserted through the guide pipe and into the top layers of the overburden, and the anchor cables adjusted to maintain the casing centred in the guide pipe. This permitted the drill to re-enter the same hole after each sample was removed.

(i) Land Drilling: Land drilling has been carried out in three areas to provide information for structural foundations and for structural materials.

A total of 750 feet in overburden and 6,550 feet in the rock was drilled at the project area, the Digdeguash pumped storage site, and at the Upper Saint John River area. Additional borings and test pits are contemplated where satisfactory construction materials have been indicated.

(j) Tidal Investigations: Automatic recording tide gauges have been installed at five locations in the bays of the project area. Charts from these gauges are being studied to determine ranges and characteristics of the tide in the various bays.

The cycle of variations, due to changing influence of the moon and sun, is repeated every 19 years. Records from the tide gauging station at Eastport, Maine, since 1930, have been studied. The plot of the 10-year average of the annual mean tide, plotted each successive year at the mid-point of the 10-year period, indicates that the tide ranges are apparently increasing at the project area.

One important problem to be resolved in this investigation is the influence, beneficial or otherwise, that the proposed tidal project may have on the existing natural range of the tides in the Bay of Fundy. To determine the answer to this problem, special investigations are being carried out.

(k) Navigation Locks Study: The project includes four navigational locks required for continued navigation during the construction period and after the project is completed. One lock located in the Letite Passage will permit traffic between the upper pool and the ocean. A second and third lock located at Head Harbour Passage, and at Quoddy Roads will permit traffic between the lower pool and the ocean, and a fourth lock located at Dog Island will permit traffic between the upper and lower pools.

A detailed study has been made of existing waterborne traffic within the project area, including number of vessels, ports entered, routes taken, loaded dimensions, frequency of trips and cargo, and so on.

Based on this study lock requirements have been estimated. The two

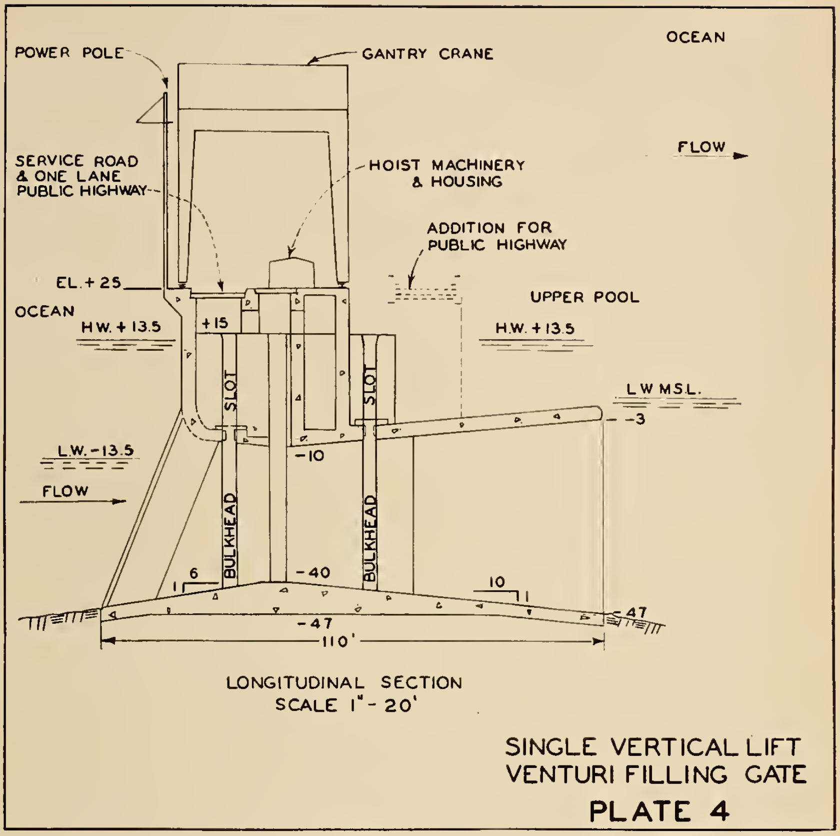


Fig. 4. From hydraulic model studies to determine coefficient of discharge on a proposed Venturi gate, the design shown above was selected for consideration.

main channel locks at Dog Island and at Head Harbour Passage will require dimensions of 450 x 60 x 21 feet and the two smaller locks at Letite Passage and Quoddy Roads will require dimensions of 100 x 25 x 10 feet. These locks will not provide for any increased traffic requirements created by industrialization of the area, but would be the maximum legitimate charge against the tidal power project, for maintenance of present navigation.

The tidal power project, if built, will spur industrial development in the area. This, in turn, may make it necessary to provide locks suitable for larger vessels than are in use at present. Future shipping requirements for the maximum industrial development of the area will probably require main channel locks with dimensions of 860 x 80 x 30 feet. The locks in the secondary channel which will be primarily used by the fishing fleet would not require enlarging. Vessels of the St. Lawrence Seaway class would have access to all the ports in the projected area.

Each lock will be provided with approach walls and a highway bridge. The gates will be sector type operating on vertical hinges. Safety fenders will be installed on each side of the gates. Stop-log gains or recesses will be provided during the construction for any emergency dewatering or repairs.

The additional construction cost necessary for the larger locks would be beyond the normal concept of providing equivalent replacement facilities and the resulting incremental cost of the larger locks would not be chargeable to the overall cost of the project. The requirements of future navigation cannot be evaluated until the cost of tidal power has been determined and the industrial potential has been evaluated.

(l) Materials for Construction: Power auger borings were taken in the fall of 1957 in areas where geological reconnaissance has indicated materials suitable for concrete aggregates and for embankment fill. Faces and pits were opened at several potential sites for embankment fill materials, and representative samples were obtained. The information obtained from the analysis and tests will enable a more accurate determination of the cost of the various structures.

The anaylsis of the core samples taken for foundation investigations are also being studied in connection with the materials for construction as it is intended to use the excavated materials for embankment dams and cofferdams wherever possible.

(m) Embankment Dams and Cofferdams: Typical cross-sections of tidal barriers are being studied in order to arrive at the most feasible section, considering location of materials, tidal currents, maximum size of rock available, equipment required, methods and sequence of construction. The problem of closure is receiving special consideration including the use of models.

A roadway will be provided on all sections of the embankment barriers, and bridges will be provided at each lock. During the 1935-36 construction period, embankment dams were built between Pleasant Point on the Maine mainland and Carlow Island, and between Carlow Island and Moose Island. Both of these structures now carry a branch railroad line.

When the project is built, the total length of embankment dams will be more than seven miles and will be in depths of water up to 300 feet. The top of the embankment dams will be 60 feet in width and will be 20 feet above mean sea level. The side slopes in general will be 1 on 1.75.

With the two-pool system, the high pool will be generally at or higher than the ocean at all times and always higher than the low pool, and the ocean will be generally at or higher than the low pool at all times, so that the head through any section of the barriers will be for the most part in the same direction. Therefore, consideration has been given to embankment dams of two general types—with an impervious core blanketed with quarried stone on each side or with quarried stone blanketed with impervious fill on the pressure. side only. Studies are being made of each type taking into consideration relative quantities, costs, and ease of placing.

Cofferdams will be required in the construction of the various structures. These cofferdams will consist of rock and earth fill and of the design similar to the èmbankment barriers. It is intended to re-use the cofferdam material for the embankment dams.

(n) Model Studies: Hydraulic model tests were conducted in 1935 on the 30 x 30 foot Venturi gate proposed by Cooper to determine the coefficient of discharge. Variation in the gate type, entrance and exit shapes, and sill elevation were tested to determine the gate with the maximum efficiency.

As a result of the model studies the gate selected is that shown in (Fig. 4.)

A model study is being made to determine the most economical method of constructing the embankment barriers. Particular emphasis is being placed on construction by end dumping methods, effect of wave action on slope materials, and method of closure.

A single model of the entire project built on a scale sufficiently large to provide useful information would not be economical.

(o) Transmission Study: A review of the existing transmission facilities in Maine and New Brunswick has been made. Studies are now being carried out to determine the future requirements and costs of the facilities required to deliver the energy output from the tidal project to existing and potential load centres.

During 1955 in New Brunswick, energy requirements were 423 million kwh. By 1980 it is estimated that the requirement will increase to 2,647 million kwh., an increase of over 600 per cent. In Maine the energy requirement is expected to increase from the 1955 figure of 2,417 to 7,160 million kwh., a predicted increase of almost 300 per cent. The largest utility system in Maine, the Central Maine Power Company, supplies 70 per cent of the power load in Maine. In New Brunswick, the New Brunswick Power Commission, a publicly-owned company, serves most of the province. The systems in each country are interconnected at the international boundary, and energy is exchanged between New Brunswick and Maine.

Transmission lines are being studied for the distribution of energy from the project throughout the State of Maine under four different conditions:

(1) The tidal project alone with a local load.

(2) The tidal project alone without a local load.

(3) The tidal project and River Hydro with a local load.

(4) The tidal project and River Hydro without a local load.

The estimated capital costs for transmission lines in Maine vary between $12 million for (1) and $40 million for (4). In New Brunswick the costs will be considerably lower as the area covered by the existing network borders on the project area, and plans are already under way to increase the voltage level of sections of the system.

(p) Pumped Storage Study: Investigations have been carried out for three possible pumped storage sites in the project area. These include Haycock Harbour, Calais, and Digdeguash River. The required foundation explorations and topographic mapping for these sites has been completed. These have indicated that the Digdeguash River site is the best and more detailed study is being given to this project so that a comparison can be made of it with alternate steam or hydro plants.

The Digdeguash River, in New Brunswick, has a drainage area of some 200 square miles and the damsite and reservoir area are located at its outlet into the northerly end of Passamaquoddy Bay. Preliminary plans are for a high-level reservoir providing approximately 100 feet of head. The reservoir will be fed by the river as well as by pumping.

Water will be pumped up into the reservoir during periods when the supply of energy from the tidal project exceeds demand, by a combined pumping and generating station consisting of 4 or 5 pump-generator units, operated with power from the tidal plant. This stored water would be used to generate power through the same units to firm up the tidal output.

(q) Period of Construction Study: Construction has been scheduled for a six year period. This period is sufficient for completion of the entire project, including the auxiliary plant and transmission lines.

Because of the international aspect and the physical nature of the project, it is probable that the construction would be carried out by a series of separate contracts.

The powerhouse constitutes the largest single major construction item and will take five years to complete. The auxiliary power unit, whether steam, pumped storage or river hydro, would be started at the same time and would be completed within three years. This schedule would permit the new capacity to go into production gradually as the demand of the power market increased. The construction of the gates, locks, and embankment barriers will be coordinated to permit maximum re-use of cofferdam materials and to permit bypassing of some of the ebb and flow currents through the gates during the final closure of the embankment dams.

(r) Fisheries Investigation: Fisheries investigations are being conducted by the International Passamaquoddy

(Continued on page 84)

The two official languages used at the World Power Conference Sectional Meeting were English and French, and a simultaneous translation service was available to delegates who attended the sessions.
Unlike some of the permanently-installed systems, the present method, which can transmit on six separate channels, may be set up in any room. It operates on the principle of a closed-circuit radio station, with individual transistor receivers and earphone set for each user. Shown with one of the sets is V. O. Marquez, deputy chairman of the sub-committee on interpretation and recording.

WORLD POWER CONFERENCE CANADIAN SECTIONAL MEETING

Montreal, September 1958

FOUNDED IN 1924 in Great Britain to further international co-operation between engineers, scientists, administrators, and economists in the various fields of power and fuel technology, there have been five full World Power Conferences plus twelve sectional meetings at which particular aspects of the objective program have been discussed.

The most recent of these sectional meetings was the first to be held in Canada, when some 1300 delegates from 61 different countries met to consider the theme 'Economic trends in the production, transportation, and utilization of fuel and energy'.

For nine sessions on various aspects of production, three on transportation, and four sessions on utilization, some 147 papers had been pre-printed and distributed to delegates in the two official languages, English and French, together with a general report summarizing each section. At the sessions, many delegates presented prepared discussion of particular items, and there was much spontaneous discussion from the floor. The subject of nuclear energy aroused so much interest that a special additional session was arranged, under the chairmanship of Sir Christopher Hinton, chairman of the Central Electricity Generating Board, Great Britain, who is responsible for the nuclear energy generating program in that country.

The question was inevitably asked 'what was the outstanding result of this meeting?' Just as inevitably, considering the size and scope of the event, there was no simple answer to the question. There was, however, a central theme running through much of the general discussion about specific papers and fields of interest, which perhaps indicates that the purpose of the World Power Conference was largely fulfilled. The theme can be based on the expression 'it all depends . . .'.

More specifically, the contributions of individual delegates and countries showed what most of the world leaders in the development of power and energy sources are thinking and doing, but, more importantly, the exchange of views helped to clear some misconceptions that may arise when comparing achievements in different parts of the world. What is sound practice in one country may appear quite impractical in another, but the meeting certainly achieved a great measure of success if it furthered the idea of thinking beyond the immediate technical problems involved.

In general it was agreed that engineering techniques, and therefore the work of engineers, tended to run along similar lines. On the other hand, economic and political pressures distort the implications of these techniques. The commercial production of electric power from nuclear energy is being developed rapidly in the United Kingdom because it is becoming more difficult and more expensive to produce the right kind of coal, whereas in the United States, for example, there are ample economic resources of fossil fuels and considerable undeveloped hydraulic resources. At the same time, there is much scope in the U.S.A. for widespread experimental and development work in the field of nuclear energy. A good example of political influence is the closing of the Suez canal, which almost within a few hours affected the level of petroleum prices all over the world and thus altered the economics of power production from this source.

The economic and technical aspects of power cannot be separated. There is a prospective world shortage of power, particularly when the future growth of 'underdeveloped' countries is considered, and it was suggested that the leading countries should concentrate on investigating the most efficient and economical means of developing their own resources, with the inference that the technical knowledge gained could eventually be applied to develop other areas, but in relation to their own particular economic conditions.

THE TECHNICAL SESSIONS

A very brief summary is all that can be given here of the large amount of material presented at the technical sessions. The individual papers, general reports, oral discussions, and reports of the general proceedings are to be published later as a bound volume of Transactions. A complete set of papers and general reports is available for reference in the library of the Institute.

THERMAL ENERGY

Generation, Conventional Fuels (System Planning)

Various papers in the discussion contributed data useful in considering the extension of standardizing of large steam turbines.

In general, present standards for steam generating units for 100 Mw. and under have resulted in reduced cost, earlier delivery, better availability and interchangeability of spare parts. Recent addition of the 150 Mw. standard seems to require modification of the steam temperature conditions as none are being ordered to the existing standard.

In the U.S.A. there is a feeling that the existing preferred standards should be extended to units larger than the 150 Mw. now standardized and for higher pressures and temperatures.

It was suggested that a 200 Mw. size standard be added in view of the large number of units of this size being ordered.

However, some objections have been made by some manufacturers to addition of higher size standards because improvements presently being made in the design of turbines could, within a relatively short time, make any standard adopted now unattractive in the new future.

Useful information from the Soviet Union on this matter indicated that 200 Mw. units are being made, and that for the next five years 300 Mw. will be widely employed. These will be 3000 r.p.m. single-shaft machines. When 600 Mw. units are adopted it is planned to have them built as two shaft units.

For European standardization, the International Electric-technical Commission accepted standards up to 100 Mw. at Munich in 1956, these of course applying to 50-cycle units.

The second topic for discussion was the increased useage of low grade fuels: one contribution pointed out that there are abundant deposits of lignite in Western Canada and that considerable interest is developing in its use. Its characteristics have to be considered. It is a successful fuel if proper care is taken of its peculiarities. In the United States the use of lignite and brown coal is apparently not a pressing matter as there is a variety of other grades of coal easily available. Lignites and brown coals are being used extensively and successfully for power production in Eastern Europe.

The third topic to be discussed is that of increasing the practice of using exhaust and extration steam for industrial purposes and district heating.

In the Soviet Union a balance is struck between the energy production capabilities of an area and the industrial potential of the area. Thereby an optimum economic relationship is present. This method of planning seems well worthy of careful consideration.

The dual supply of electric energy and steam from electric plants is important in other respects. In common with other systems supplying metropolitan areas, the Consolidated Edison System of New York City is experiencing a greater rate of load growth in the summer than in the winter due primarily to the impact of commercial air conditioning requirements, so that the annual peak loads have shifted from the winter to the summer season. In many instances, it has been found to be more economical to utilize steam instead of electric drive

Senior officials of the World Power Conference shown here, from left, are: G. A. Hathaway, vice-president; Sir Harold Hartley, honorary president; Maj. Gen. H. A. Young, vice-president; Franz Holzinger, president; Sir Vincent de Ferranti, chairman; and C. H. Gray, secretary.

for the air conditioning of buildings adjacent to steam supply mains.

In Belgium, as elsewhere, the two main factors considered in planning the combined supply of heat and electrical energy are the low load factor of the heating load and the relatively low density of that load, which involves extensive piping systems with high capital costs.

The last topic for discussion was the combination of the heat cycles of gas turbines and steam turbines to obtain the more efficient use of fuel used in power production.

It was reported from the U.S.A. that the main objection to the use of gas turbines on utility systems there is the small capacity of the gas units; and that, moreover, the gas turbine has not yet been properly developed for use with coal as fuel. However, one point is obvious and that is that the gas turbine has a distinct advantage, a peaking and or emergent unit easily adaptable to remote control and where fuel costs are of secondary importance and the reduction of spinning reserve of major importance.

A discussion from Switzerland points out that in comparing the combined gas turbine—steam cycle with the conventional steam cycle it is important to take into account the fact that the combustion cycle sacrifices to some extend the gains inherent in regenerative feed heating.

Discussion from France states that the combined cycle makes for gains in specific heat consumptions without going to excessive pressures and temperatures in steam units.

The free-piston gas generators are an admirable source of pressure in these cycles, being easy to regulate as they work on a substantially steady load. They give a considerable gain in output and a flat efficiency curve without involving serious trouble in operation.

Another discusion from France states that combined cycles seem to offer the best way of reducing heat losses to a steam turbine condenser. Many combinations exist. Free piston gassifiers are of great benefit and aid in achieving these results. Generally, it was felt that combined cycles reduce heat losses and should therefore be studied intensely.

A. S. Pavlenko, who was leader of the delegation of engineers and scientists from the U.S.S.R., is here seen addressing one of the technical sessions. Mr. Pavlenko later presented the Canadian National Committee with a set of three films dealing with Soviet power developments.

THERMAL ENERGY
Oil, Gaseous Fuels

The papers offered in this session dealt with the general energy supply and requirements situation, exploring the subjects of reserves, exploration, drilling, marketing and the production of synthetic gas from coal.

A major theme was the current and future pattern of fuel and energy demand to be met from oil and gaseous fuels.

The discussion at this session covered trends in future prices of natural gas and one contributor discussed trends in the delivered cost of gas in the U.S., pointing out the shift which has taken place in the share of the delivered price attributable to the field price of the product.

Another contribution called attention to the lack of reliable cost information and the inherent difficulties in allocating separate costs to oil, gas and other hydrocarbon production. It was believed that the difficulties involved are a challenge to the industry and governments concerned and that greater efforts should be made to maintain accurate statistical and cost records.

Two contributors quoted estimates of reserves and one of them stressed the importance of such estimates in future planning. The importance and value of such estimates was discounted by one contributor who suggested that they have little meaning and might even be considered as dangerous.

THERMAL ENERGY GENERATION, CONVENTIONAL FUELS (DESIGN AND OPERATION)

Six papers had been accepted in this Section and sent to all delegates prior to the opening session.

The paper by Messrs. Sporn and Fiala aroused extremely wide interest. This reported on the first nine months operation of the world's first major steam generating unit at Philo Plant in Ohio, U.S.A., of 110,000 kw. capacity, which operates at the supercritical steam pressure condition of 4,500 psi, 1150° F. with double reheat at 1,050° F. The steam is produced in a "once through" steam generator, in which the conventional steam drum is not required. Despite initial "teething" troubles on some of the ancillary equipment, the main components of steam generator, and turbo-generator have performed satisfactorily and enabled a new high in thermal efficiencies to be established.

However while the technical problems can be said to have been solved, there was a general feeling that such plant is probably not yet an economic proposition, due to the high capital costs involved in construction. However most speakers considered that not many years would elapse before large supercritical units would be an economic solution, for increasing power capacity on large networks.

Further papers were considered which dealt with the problems of using low grade fuels in steam power plants. Two Belgian authors had presented a paper dealing with the handling, separation and drying of slurries, prior to use in the steam boiler furnace. A Russian speaker discussed the problem of burning anthracite dross as it was tackled by the Soviet Union. A French speaker discussed the difficulties related to using low grade fuels with very high ash content and which are having to be burnt in ever increasing proportions in his country.

A paper presented from Czechoslovakia dealt with economic solutions of combined electric power generation and district heating schemes, brought forward several speakers who discussed the great economies that could be achieved provided that high load factors (upward of 50%) existed on the heating load system. This conclusion was claimed to be still valid, despite the important advances achieved in the efficiency of generation made by very high pressure condensing steam units.

The problems, inherent in choice of location of steam power stations, were dealt with by an Italian speaker, covering widely different geographical conditions which exist in his country.

Speakers from France and Italy reported on the progress made in their respective countries using conventional fuels for the production of steam and electric power.

The concluding speaker foresaw that in his country, the U.S.A., some 150 million kw. of new plant capacity would have to be installed in the next ten years; and that by 1968 he anticipated that supercritical conditions would be common practice together with fully automatic operation of such steam power stations.

THERMAL ENERGY—COAL

In the opening ceremony, Sir Harold Hartley, remarked: "Never before has there been available so wide a choice of sources of energy, suitable for use in varying circumstances". Coal is our oldest and most widely employed source of energy and, as the better and more accessible deposits are worked out, the problems encountered in its economic applications become greater and more numerous.

It was pointed out that high moisture content is no longer a serious problem, if the coal is burned in pulverized form and provided that a high air preheat is employed. With certain lignites, adequate ventilation is necessary to avoid overheating of the coal in storage. Underground wetting methods may result in the fine coal being too wet to screen at the pit heads, but this difficulty was not regarded too seriously.

Several speakers remarked on the steadily increasing percentages of ash (in some cases, up to 60%) which necessitate the use of coal in the pulverized form, preferably in large boiler furnaces. The fusion temperature of the ash largely determines the method of its disposal, either dry or in the form of slag, and so influences the design of the furnaces themselves. Suitable provision must also be made for the removal of ash and dust, both from the heating surfaces and from the gases entering the chimney. The various air pollution control acts specifically limit the amount of dust and gas that may be omitted into the atmosphere and these laws are becoming increasingly stringent. For the purpose of limiting these undesirable emissions, the use in series, of cyclones and electrostatic precipitators, having efficiencies up to 97 per cent, is now standard practice.

There is a definite general tendency toward the increased use of fine coals and this indicates the desirability of avoiding transportation difficulties and, at the same time, reducing costs, by generating electrical energy at, or near, the pit head. This tendency implies also the desirability of locating industries and power consuming communities near to the coal fields but, however desirable this may be theoretically, it is not always feasible in practice, because these communities require supplies other than power and, moreover, the water resources available are sometimes inadequate or unsuitable. In such cases the use of jet condensers and indirect air cooling, was suggested.

In Great Britain, the amount of large sized coal used has decreased by 23 per cent, since 1950 and that of small coal has increased by 32 per cent in the same time. Domestic heating by means of coal fell by 17.8 per cent, between 1921 and 1956.

Canada has large coal reserves located in the East and West respectively, but the area of maximum consumption is in the centre of the Dominion. As a consequence of this, Nova Scotia, recently, had a stockpile of 1,400,000 tons and a serious unemployment problem involving 10,000 miners. A new government freight subvention has resulted in the potential sale of some 500,000 tons, but this is a palliative, rather than a cure. It is hoped that the St. Lawrence Seaway will help to relieve this situation by reducing transportation costs.

The situation in the U.S.S.R. in connection with the transportation problems and the use of lower grades of coal is of a similar nature to that described by other speakers. In all cases, the economic radius of transportation evidently increases with the quality of the coal. It is claimed that the U.S.S.R. has successfully surmounted the difficulties met with in pulverizing anthracite dross.

Centralization and Methods of Control

The logical applications of the principles enumerated above suggest the advisability of employing large units and this, in its turn, implies a considerable degree of centralization and the controls associated therewith. Not only are more capital funds made available, but they can be applied to the best advantage. Planning on a large scale is facilitated, the best technical services can be obtained, more standardization becomes possible and further advantages accrue from the centralization of labour negotiations and from a monopolistic market.

Mining Operations

The general tendency toward increased mechanization and a greater amount of fine coal that results from it, was discussed in detail as far as it applies to British mines. With room and pillar mechanization, the output per man-shift increases fairly steadily with the seam thickness up to and exceeding 7 feet but, with longwall mechanization, there is a steady increase up to a thickness of 3 feet and beyond that the output remains steady, or decreases slightly, as the thickness increases. The problems associated with seams thinner than 3 feet are low output, short faces, high costs, the use of small machines and greater difficulties with faults. There is also more dirt and less room for its disposal.

With seams thicker than 6 feet, strata control is more difficult, accidents from falls are both more frequent and more serious and the roof supports are heavy to handle.

The limiting depth for roof and pillar working is considered to be 1500 feet, but longwall operation is not seriously affected by depth, provided that the face is kept moving.

Obviously, conditions such as heat, gas and dust become more serious as the depth increases. Roadway conditions also are adversely affected and costs are increased. Their seams are affected economically, to a greater extent than thick seams.

Comprcssed Air and Electricity for Underground Operations

The overall efficiency of a compressed air system varies in practice from 5 to 15 per cent, as compared with 60 per cent for electrical machines. It should be noted here, by way of comparison that, in one paper, a much lower figure is given for compressed air efficiency.

Compressed air operation is evidently preferable from the standpoint of safety in cases where gasey seams are encountered, but some accidents have occurred with these systems. Methane drainage is widely practised in Britain and has been generally beneficial. The use of electricity makes it possible to supply power conveniently to the larger and more powerful machines that are now being installed and the dust problem is reduced. Compressed air operation is declining in British mines but, nevertheless, there are some operations in which the use of compressed air is almost unavoidable.

Mr. Lorimy also favours the use of electricitv and gives some representative figures from French practice, which indicate its superiority, provided that suitable precautions are taken.

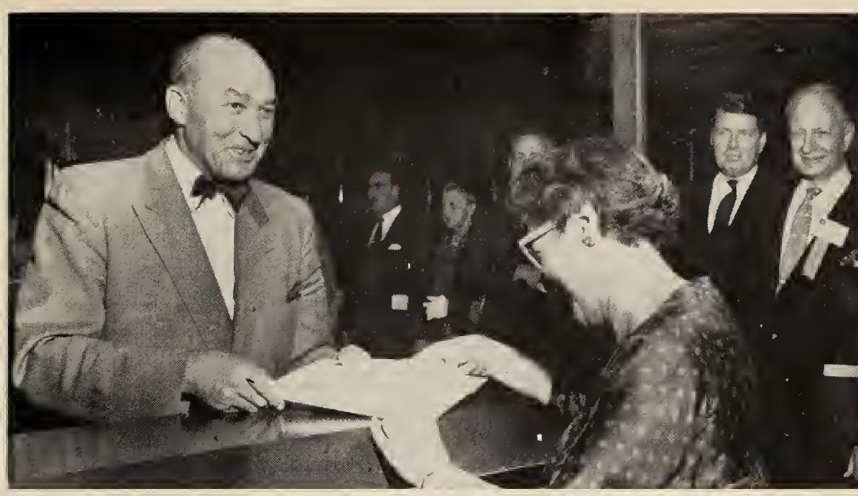
Other Applications

The use of small sized coals for producing gas, or for the liquefaction of coal, was suggested. This would not onlv reduce the drain on our liquid fuel resources, but would provide an outlet for low grade coals which might be displaced by a wider application of atomic power.

PRODUCTION—THERMAL ENERGY

Nuclear Energy and Nuclear Fuel

The world is entering a new phase in the development of nuclear power for central station applications. The early excitement and interest in a wide variety of possible types of reactors appears to be subsiding and is being replaced by sober concentration on a few. The major competitive types are the gas-cooled graphite reactor and water moderated reactors, but there is a growing universal interest in heavy water moderation. An important aspect of this new phase in nuclear power development is that



Although the World Power Conference was not an E.I.C. meeting, nearly all the members of the Canadian National Committee are also members of the Institute. Members of E.I.C. headquarters staff were present to help with registration, reception, information, and the internal post office for delegates. Dr. L. Austin Wright, HON. M.E.I.C. (extreme right), general consultant, E.I.C., who was chairman of the registration and reception committee, watches Maj. Gen. H. A. Young, M.E.I.C., chairman of the Canadian National Committee, at the registration desk.

in recent years several experimental power stations have gone into service around the world and designers are looking to the performance of these plants to provide a firm foundation for advances in design and to point the way to economies in construction. This is already bearing fruit in the United Kingdom, where the latest gas-cooled graphite designs enjoy the benefit of the pioneering experience of Calder Hall.

The United States has the largest and most varied experience with reactors. Nine civilian power reactors have produced electricitv, including Shippingport with 60,000 k.w. output. Many designers consider that enrichment can be used to lower capital costs appreciably, e.g. by permitting a larger ratio of sheath to fuel and therefore higher specific powers. The annual fixed charges are so high for private financing that the capital savings may outweigh the extra fuel costs for enrichment and it is questioned whether natural uranium reactors can become important in the United States except through government financing.

The discussion at the main session and at the additional session was very extensive, and cannot be dealt with in full here. However, the subjects discussed included the availability of nuclear fuels, various aspects of reactor design, and the economics of power production from nuclear energy sources.

In recent years it had been considered that the technical development of nuclear power might be restricted by a lack of economically-available fuels (uranium and thorium). Now the position had reversed, and the state of technical development was tending to restrict the market for the now abundantly available mineral fuels.

There were considerable differences of opinion on the economics of nuclear power production, but it was largely agreed that many of these differences were due to the varying approaches made in different countries to such subjects as capital costs, amortization, fuel costs, and so on.

The subject of nuclear power in Canada is discussed more fully in a paper on page 63 of this issue of the *Journal*.

HYDRAULIC ENGINEERING—SYSTEM PLANNING

This section discussed 13 papers, three submitted by Canada, one by Austria, one by Great Britain, one by Italy, one by Poland, one by Spain, one by Soviet Union, two by United States, and two by Yugoslavia.

The papers covered many features of hydraulic production and emphasized the importance of correct technical and economic planning of the facilities of various kinds, so that the least cost to the consumer of electricity will result.

The four points suggested for discussion by the General Reporter, Dr. G. R. Lord, brought forth discussions which occupied the whole of the allotted time for this meeting. Point No. 1 for discussion was intended to be provocative, and achieved the desired result, although there was no unanimity among those who discussed the order of development of hydraulic sites.

A number of the speakers in this discussion covered various aspects of the planning for pumped storage, which has become recently attractive to system planners in widely separated areas. It was pointed out by one speaker from Great Britain that there were features unique to each pumped storage development. His interesting discussion outlined some of the factors which were considered in a proposed pumped storage development in Scotland, and gave the conclusions they had reached. They had found use of a digital computer of great help to them in reducing the time which would otherwise be required to do laborious calculations. This is just another example of the value of this very versatile tool that can be used where engineers are making a comparison of alternative facilities, to determine which is the most economic. These computers are becoming available in ever increasing number, and have proved of immense value in relieving engineers of the necessity of making time consuming routine calculations, so that their time can be more profitably spent on other matters requiring their special knowledge and experience.

Other matters receiving the attention of the speakers at this session were:

(1) The proportion and function of hydraulic, thermal, and nuclear plants in an overall system plan where each of these types was to be used. One speaker announced what he considered to be a radical suggestion for a mixed highly economical steam stations operated continuously to carry base loads with a series of hydro electric storage plants with sufficient added capacity to carry variable and peak loads. If conditions were right, this had been proved in at least one case of which he had knowledge, to result in most economical operation.

(2) The advantage of studying the development of all the energy resources of a region to arrive at the most economic overall plan was stressed by several speakers. Their very interesting discussions outlined how each had attacked the problem giving proper weight to the features peculiar to his own region, and the form of the planning and the order of development which resulted.

(3) One speaker emphasized the importance of transmission costs where the power was generated remote from the load. In cases of this kind, the transmission cost might be a controlling factor.

HYDRAULIC ENERGY—DESIGN AND OPERATION

Of the seven papers, five dealt directly with details of construction and manufacture of hydraulic turbines and of pumps for storing water for use in hydraulic turbines. One paper described a large pumped storage scheme for developing power at periods of peak demand using water stored during off-peak periods. One paper was an analysis of a scheme to make available tidal energy on a firm basis, utilizing a design of pump turbine which can act as a pump, a turbine, or a sluice in either direction. The proposed scheme would enable dependence on some tidal power for peak periods no matter what time of day the demand were experienced.

During the discussion of the papers, evidence was presented of successful operation in France of two experimental designs of turbines for tidal schemes. It appears that France is much nearer to an economical solution of the problem of obtaining power from the tides than we have been heretofore.

The seven papers reported work done in six countries. A seventh country was heard from during the discussion, in a report on very large units being built in Sweden.

The discussion brought out that differences in techniques in America and Europe may be due largely to the different requirements of the economies of these areas.

Discussion of the papers was under four headings:

(1) Adjustable blade turbines and pumps — The outstanding contribution under this heading was the description of the development of the Deriaz pump-turbine in Great Britain — an adjustable blade diagonal flow turbine and/or pump.

(2.) Fixed blade turbines and pumps — Possibly the most newsworthy paper in this category was a description from Switzerland of successful operation of high head multistage pumps in reverse, producing power as turbines.

(3.) Bulb or tubular turbines — The report from France, mentioned above, kindled much interest in this subject. A Swiss report added to the information on various design schemes for tubular turbines, such as might be applied in small streams with small available heads.

(4.) The use of new alloys — In this category mention was made of the use of high tensile steel for the stressed plate steel parts of hydro developments, and of the use of stainless steel to reduce maintenance problems.

HYDRAULIC ENERGY—GENERAL

N. S. Lalander (Sweden) observed that the questions recommended for discussion are not amenable to definite answers. For instance, the economic limit of development of hydro resources is generally determined by the production costs of hydro power as compared with thermal power. Monetary comparisons are insufficient: the special merits of the production sources must be compared.

The economic limit of hydro development, based on cost comparison with thermal power, changes from time to time. The first evaluation of the economic limit of development for Swedish water power was figured at 32.5 x 10° kwh per year in 1923. Successive re-evaluations have raised this figure to 80 x 10° kwh per year from a gross of 200 x 10° kwh. Only 29 x 10° has been so far developed.

The relative economic value of winter energy in Sweden is placed at roughly twice the value of summer energy, due to relatively good regulation possibilities.

The Norwegian, Finnish and Swedish systems were expected to be interconnected, establishing a major Scandinavian power pool. Factors underlying this are the relatively radically reduced costs of necessary interconnections and the differences in storage possibilities in the three countries.

Mr. Adams (United States) noted—

(1) Only under most unusual circumstances is it feasible to develop hydroelectric plants for utilization in a purely hydroelectric system.

(2) The fullest and best use of hydro resources require that they be operated in combination with thermal plants.

(3) Some hydro sites can only be economically developed when they can be tied into a large system.

With reference to the subject of developing power from tidal waters, an article on the engineering aspects of the Passamaquoddy tidal power project, Bay of Fundy, appears in this issue of the Journal (page 67).

(4) Long-range planning is necessary for the proper design of hydro projects to ensure maximum utilization of the potential of each site, with system development.

However, (1) and (2) above are open to question in many areas, with attractive hydro resources but uneconomic fossil fuels.

G. Bardon (France) compared observations bearing on the relative values of the types of energy, i.e., peak, base, winter, summer, day or night. The comparison shows the following:

Base hydroelectric, 6500 hours' use	1
Hydroelectric energy from stations with reservoirs providing weekly storage	1.5
Energy from alpine reservoirs with seasonal storage	2.5 to 2.7
Peak energy, about 1000 hours' use	3 to 3.5

Mr. Bardon further noted the value of hydroelectric developments with small reservoirs providing daily or weekly storage, the increasing value of seasonal storage and improved utilization of water, as well as the reliability of hydro power for less densely developed areas.

J. Tissier (France) discussed the basis on which Electricité de France compares a hydroelectric and a thermal development providing the same service; that is, in a dry period, the capacity available on peak and the energy productibility on winter days. He also drew attention to the necessity of making this comparison over the lives of the two types of plant: 30 years for thermal plant; 40 years for the equipment and 100 years for major civil works in hydroelectric developments.

J. K. Hunter (Great Britain) stressed the significance of pumped storage to the United Kingdom program of some 5000 to 6000 Mw. of nuclear plant by 1965 in combination with larger and larger thermal units. He drew attention to the possibility of pumped storage based on sea water and noted the several problems which might arise therefrom. These are:

(1) Effect of salt spray blown from the reservoir onto adjacent farm land.

(2) Contamination of local wells and surface streams from deep seepage of salt water through the rock formation underlying the reservoir.

(3) The possibility of chemical reaction between the salt water and the surface deposits forming the floor of the reservoir with increased permeability, as possible with certain types of clay.

O. G. Gimstedt (Sweden) observed that redevelopment of Swedish waterpowers began at a slow rate about 1935, with about 10 per cent of the approximately 1000 Mw. installed by 1930 now replaced. A further 15 per cent will be replaced during the next 10 years. Redevelopment frequently involves several stations being replaced by one, using larger dams and longer tailrace tunnels, with higher head and higher water usage.

The stations which have been replaced have had an operating life of 30 to 60 years, with an average of 45 years.

A criterion proposed is that replacement should occur when the loss occasioned by shutting down an existing plant is offset by possibility of redevelopment of the head more cheaply than undeveloped waterpower elsewhere.

Dr. C. Marcello (Italy) drew attention to the factors influencing the relative economic values of the several types of hydroelectric energy and concluded:

(1) Peak energy is worth three times base energy;

(2) Day energy is worth two times night energy;

(3) Winter energy is worth three times summer energy;

(4) Seasonal storage energy is forth four times run-of-river energy, at least for Italy and some other areas.

Dr. Marcello noted that new construction, under execution or planned, would increase developed waterpower to about two-thirds of that now considered possible. As regards intensification of thermal plant construction, he considered it would increase the possibilities for attractive hydroelectric development.

W. A. Dexheimer (United States), in discussing the relative values of energy, described the Bureau of Reclamation's proposal concerning the sale of peak capacity. He noted that, because of the multiple-purpose characteristics of the Missouri River developments — navigation, irrigation and power — seasonal firm power is sold at standard firm power rates.

Mr. Campbell (United States), in discussing country-wide power pool, stated that this is not yet the case in his country. However, there were several extremely large regional pools. He noted advantages of pool operation as:

(1) Savings in capital expenditures

(2) Operating economies

(3) Improved service reliability.

I. V. Komzin (U.S.S.R.) briefly described the notable Kuybishev. He noted an interesting feature — the provision of outlets, above the draft tubes, enabling a 30 per cent reduction in the length of spillway facilities.

I. N. Ozerov (U.S.S.R.) reviewed the factors generally dictating the development of hydro systems and the impact that thermal stations might have in his country. In listing the items bearing upon regional hydro developments — uniformity of run-off, storage, possibilities, etc., Ozerov emphasized the advantages to be obtained, when feasible from the consolidation of separate individual systems.

Dr. C. Semenza (Italy) drew attention to the significance of model tests on high dams and other hydraulic structures and, particularly, to the outstanding work in this respect accomplished at Bergamo. He noted that the best scheme does not necessarily give the maximum output for a project. In addition, Dr. Semenza remarked on the importance of storage reservoirs, pumped storage and underground plants in the modern Italian power economy.

Dr. O. Vas (Austria) gave an interesting treatment of Austrian experience in evaluating the relative value of the several forms of hydroelectric energy, based on the wholesale tariff used by the network for power sales to the provincial distribution companies and a few large industrial consumers.

He noted the practice of the German-Italian-Austrian regional group, which places the following relative values on power interchanges between the three countries:

(1) Winter (November to February)	
peak hours	4
off-peak hours	2
(2) Summer (May to August)	
peak hours	2
off-peak hours	1
(3) Transition months	
peak hours	3
off-peak hours	1.5

OTHER SOURCES – PRODUCTION

Two papers were presented — one on geothermal power sources and one on solar energy utilization in North America.

Professor Tomasi Sais of Spain proposed a novel hydraulic machine for the utilization of thermal or solar energy and developed a mathematical theory. Regrettably, time did not permit a full description of the proposal. Didier Olivier-Martin described a method of extracting water from steam by means of a turbine designed in France associated with a natural uranium air cooled reactor.

Sir John Hacking discussed the utilization of wet steam and stated that the problem has been solved in New Zealand by deriving dry steam from wet steam by flashing or separation. Professor Alcutt discussed the use of solar energy for house heating and described some solar installations. Dr. Parker suggested that we are too pessimistic regarding the exhaustion of fossil fuels and believed that the rate of increased consumption currently forecast is unduly high.

TRANSPORTATION— ELECTRIC TRANSMISSION

The rapidly rising cost of right-of-way is of paramount importance in determining the transmission voltage and the number of circuits, and is of greatest interest where transmission lines must be located through cultivated and urban areas. One contributor stated that the necessity of installinga limited number of overhead lines and the large bulk of power to be transmitted dictated the use of transmission lines at 275 kv. on double circuit towers.

Sincere cooperation in the operation of interconnected systems can result in delivering cheaper power to the consumer. The operation of this system illustrates that through a common need national boundaries become of secondary importance.

The superimposing of higher voltages on existing transmission lines and electrical systems in their present form, or with some modification, is extremely interesting as a solution in producing economies in electrical transportation. Years of operating experience have shown that in some transmission lines unnecessarily high overload factors were incorporated, and on this basis it is possible to super-impose higher electrical loads. Many recent lines are designed to take advantage of this saving in capital investment. One speaker from Sweden, noted however, that although it is possible to theoretically produce a saving by superimposing 500 kv. or 650 kv. on the existing 400 kv. Swedish system, its extent is such that the savings would not be achieved in practice.

Studies of the economies of fuel versus electrical transportation indicate in general that it is more economical to locate the thermal plant adjacent to the source of fuel and to transport the electrical energy to the area of utilization. One contributor observed that in Britain the transportation of electricity is cheaper than the transportation of the coal by rail above a critical distance of approximately 50 to 70 miles, and that this is directly opposite to the situation in the United States, and again a French contributor reported that in France a specific study indicated that it was preferable to transport the coal. From this we deduce that local problems and the national economy must be very carefully considered in any study of this vital problem.

There is an increasing awareness of the possibility of economies in the transmission of electrical energy by a direct current system. Although much of the work on d-c transmission is in the study and research stage, the existing installations have provided much useful knowledge. Further studies and investigations are required due to the increasing demand for the economic transportation of large blocks of electrical energy over long distances and for submarine cables. This is a subject where all countries and organizations can co-operate by pooling knowledge and experience to produce economies in electrical transmission for the benefit of all.

The difficulties inherent in attempting to make economic comparisons of the complex problems involved in the transportation of electrical energy were well expressed by an English contributor. The technical aspects must be carefully evaluated against the economic considerations which can only be applied as they refer to the situation in the immediate vicinity.

Through design, research and economic studies, the future in the economical transmission of electrical energy is in the use of much higher a-c voltages than presently being used, the greater application of d-c transmission, and the greater use of interconnected systems.

The effect of diminishing reserves, higher priority uses and increasing costs will make the use of gas and oil untenable for mass production of electric energy in future years. Furthermore, energy production by atomic fuels is not expected to be low in cost in the near future, so it seems likely that coal fuels will be used to supply most of the United States' additional energy requirements for some time. It is also felt that voltages in excess of 500 kv. are desirable and that it is important to develop more economical transmission line designs.

A contributor from U.S.S.R. noted that for the Soviet Union, with its large territory, the establishment of a united power system must be implemented by the creation and uniting of power systems within economic and geographical regions. A united power system for the European part of the Soviet Union and Siberia is being established, and the final aim is a united system for the Soviet Union.

TRANSPORTATION — RAIL, WATER, ETC.

Five papers were received for this session. From a review of these emerged the close relationship which exists between transportation agencies and the power industry. Each is vitally dependent upon the other both for technically efficient operation and, more importantly, lowest cost operation.

There was no prepared paper on the role of highway transportation in the movement of fuel products, but during the discussion direct reference was made to the growing importance of short haul coal movement in the United Kingdom where currently 20% of coal for steam power plants moves by road transport.

The same is true in a number of other countries. It is also recognized that in the movement of petroleum products road transport, due to its extreme flexibility, has a competitive advantage in the short haul field inasmuch as many of the consumers of gas and oil are located along the road itself. Road transport, therefore, while less important as a carrier of fuels, than either railways or water carriers, does make a contribution in the transportation of fuels for power and allied uses, which should not be overlooked.

No paper considered the relationship between the location of power generating plants and transportation costs. This too is a matter of growing importance in that generating plants today have, within limits, the alternative of locating either in the consumer market and transporting fuel to the plant or building at the mine site and transmitting power to the consuming centres. Trends in transportation charges are of particular interest to the Power Industry and this subject was referred to in its relation to the various types of fuel. Liquid fuels are found to be in a particularly favourable position in this regard. The quite different and complex position where transportation by rail is involved was dealt with by two contributors to the discussion.

From the U.S.A. there was an interesting contribution showing the trend toward increase of movement of fuel by water carriers.

It was clear that in respect of both rail and water transportation economies in cost and efficiency were being realized through technological developments.

The striking efficiency of transportation in the international movement of fuels is amply attested to by the remarkable extension of the international market for fuel products since the late 30's. At a time when world production of fuels are at a peak an ever increasing proportion is entering the international market — some 20% in 1957 compared to less than 15% in 1937. Then too there has been an even more striking growth in the length of transportation haul — an increase of 50% over the same period, from 4,000 to 6,000 miles bringing virtually every country within the economic range of world fuel resources. The importance of this to under-developed countries is profound as ample supplies of reasonable rates is basic to improved standards of living.

Regarding the relationship between transportation rates and power costs, the importance of transportation costs of moving fuel should not be exaggerated. For example, fuel frequently moved thousands of miles to consuming markets without seriously affecting power costs. In Canadian railway operations, great efforts were being made to reduce operating costs; the average annual reduction in railway costs was approximately 2%. All forms of transportation are complementary rather than competitive insofar as the transportation requirements of fuel are concerned. Frequently railways cannot provide a complete service as is also the case of water carriers.

TRANSPORTATION—PIPELINE

The need for pipeline transportation for oil and gas has been obvious for a long time, but due to the geographical relationship between source and consuming centre the economic possibilities with their potential risks are not always easy to assess and great care must be taken in the evaluation of each project having regard to the large investment which is involved.

In this session there was no obvious common theme expressed in the papers presented and this is perhaps a reflection of the individual character of each project.

International pipelines might conceivably play an important role in developing cooperation between countries in the course of meeting mutual needs.

The economics of pipeline transportation in Poland was the subject of one paper and one of the main problems touched upon was the lack of heavy concentration of demand as a factor contributing to high production costs.

A French contributor amplified reference to underground storage of gas in France. The importance of this was not merely the obvious advantage of looking after fluctuating consumption but also its value in matching the delivery capability of the wells to the capacity of the gas treatment plants since the fixed charges associated with the latter represent a large component of operating costs.

The value of computers in determining optimum operating conditions was dealt with in the course of the discussion, and the elimination of human error, and the increased speed of proper reaction to changing conditions, in the interest of maximum economy in operation was of great value.

UTILIZATION OF ENERGY
Industry and Commerce

In this session all contributors stressed the importance of energy as an essential factor influencing economic growth.

In some cases this matter was dealt with in general terms, whereas in others the treatment was quite specific, attention being focussed either on efficiency of use or on the availability of different types of fuel and the effect of this on the pattern, past, present and future, of individualism in the various countries in respect of their power problems.

A contributor from France outlined various aspects of the overall problem in a country facing the need for more energy — on the one hand more energy in its various primary forms and secondly better utilization. In France the replacement of obsolete thermal stations had increased available energy from coal by a portion of 2 or 3. A Central Committee of energy utilization studies such problems. A contribution from Japan described load factor improvement by the production of such storable products as calcium carbide from otherwise surplus hydro power, and a paper from Sweden referred to the use of electrical energy in the melting of iron sponge.

Though there were disclosed numerous similarities in the use patterns of different countries, the manner in which they were supplied appears generally to be very fluid. Industrial and commercial requirements are growing more rapidly than the national average while residential and transportation usage is increasing less rapidly. The data from such widely diverse countries as Canada and India seems to confirm this view.

UTILIZATION OF ENERGY
Farm and Residential

The ten papers submitted to this section fell roughly into two categories. First, the historical development of energy use in specific areas, and the impact of this development on living conditions and productivity; and second, the description of a particular use or development in a particular area.

Electrical energy was emphasized in most papers, though some mention was made of the use of solid, liquid, and gaseous fuels for heat and combustion engines.

Papers discussing applications covered such subjects as space heating, irrigation and drainage, and rural electric distribution system design.

UTILIZATION OF ENERGY
Transportation

The papers in this group dealt with a comparison of various fuels in the transportation field, and discussed the factors which make a change in type of fuel necessary or desirable.

The motive power used for railroad operation depends on several economic factors, particularly the fuel costs, which may amount to between 20% and 50% of total annual costs.

Conversion to diesel operation is almost complete in the United States, with Canadian railroads now in the final stages of a similar conversion. In Europe there has been some conversion to diesel locomotives, but there is a greater tendency towards electrification.

It is possible that the gas turbine or free-piston gas turbine unit may become attractive, particularly as they can use cheaper fuels than the conventional diesel engine. However, it was considered unlikely that the nuclear-energy powered unit would be considered as practical for a long time. Rather, attention might be paid to the use of large nuclear power plants, linked in a common system, to provide electrical power for railroad systems, particularly where these operated over great distances or in areas in which such power was not available from conventional sources.

International Passamaquoddy Tidal Power Project

(continued from page 74)

Fisheries Board to evaluate the effect that the tidal project will have on the fishing industry in the area. This Board is responsible directly to the International Joint Commission and will report separately from the Engineering Board. Close liaison exists between the two boards. The Fisheries Board consists of Canadian and a United States sections and is assisted by federal, state and provincial agencies.

The investigations being conducted by this board include fish catch statistics, biology, habits, environment, under present conditions and forecasts of the effect on the fish life in the area of the proposed structures.

Estimates of the monetary value of any damage or benefits to the fishing industry in the area, attributable to the project, will be used by the Engineering Board in its estimate of the cost of the tidal project.

(s) Economic Study: Economic surveys are being carried out separately for the State of Maine and for the Province of New Brunswick to determine all possible uses for the new power which would become available when the tidal project is built, and to determine benefits to the industrial and economical development of the state and province. Emphasis is being given to a study of possible new industries which might locate in the project area, particularly industries which can make use of a varying supply of power.

CONCLUSION

The decision to build the Passamaquoddy Tidal Power Project will be taken by the Governments of the United States and Canada, and this decision will be based on the results of the present investigations. The final reports from the Engineering and Fisheries Boards, to be the International Joint Commission, are scheduled for completion by October 1959. The Commission, after reviewing the findings of the Boards, will make its recommendation to the Governments of the United States and Canada.

The long debated question of the economic feasibility of harnessing the tides of the Passamaquoddy region will be answered soon after October 1st, 1959, and forty years of speculation based on incomplete information will be ended.

1. Energy From The Sea. Water Power, Dec. 1956, p. 457.

TRANSACTIONS

OF THE ENGINEERING INSTITUTE OF CANADA

The fourth issue of Transactions in the present series, (Vol. 2 No. 3) will be mainly the proceedings of the Conference on the Bearing Strength of Ice. This Conference was held in April 1958 under the auspices of the Division of Building Research of the National Research Council.

Titles of the articles in this issue will be as follows:

Ice Landings, C. H. Duff.
The Preparation of Ice Landings by Pulp and Paper Companies in Eastern Canada, L. B. Rose and C. R. Silversides. Preliminary Measurements of the Strength of Melting Lake Ice, D. F. Barnes. Recommended Standards for Small-Scale Ice Strength Tests, T. R. Butkovich. Preliminary Results and Review of Sea Ice Elasticity and Related Studies, D. L. Anderson. Deflections of Plates on Elastic Foundation, L. W. Gold, L. D. Black, F. Trofimenkoff and D. Matz. Relative Strengths of Plates on Elastic Foundation, L. D. Black. The Theory of a Narrow Infinite Wedge on an Elastic Foundation, D. E. Nevel. Discussion of papers.

The fourth issue will be distributed to members during the next month. Publication date of September, announced in the September issue of the Journal, has been delayed.

Transactions can be mailed to non-members of the E.I.C. on request, at the cost of $1.00 per copy. Subscriptions to Transactions can be arranged through E.I.C. Headquarters.

INTERNATIONAL NEWS

INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY

THE SECOND United Nations International Conference on the Peaceful Uses of Atomic Energy was held, 1st to 13th September, in Geneva. A brief summary of the main features of the conference is given below.

On 22nd September, the General Conference of the International Atomic Energy Agency (IAEA) opened its second session in Vienna, Austria, and elected Dr. Tjondronegoro Sudjarwo (Indonesia) as president. The IAEA is an intergovernmental organization under the aegis of the United Nations, with a permanent scientific staff. It investigates and co-ordinates many phases of the use of nuclear energy either as a direct service to individual nations or as a general service to all nations. The session benefited from the experience recently gained at Geneva.

The Geneva Conference

This year, 48 governments and six intergovernmental agencies submitted 2135 papers, compared with 1076 in 1955. Of the 6300 participants, 2700 were members of government delegations from 69 countries (1428 official delegates in 1955).

A scientific exhibition held as part of the conference was seen by some 100,000 visitors. It included displays set up by 20 governments and two organizations in a special temporary structure with 8,000 square metres of floor space.

FUSION INVESTIGATIONS

In his closing address to the conference, the President, Francis Perrin, French High Commissioner for Atomic Energy, stressed the importance of "unreserved disclosure, in the most important fields," that occurred during the session. In the field of controlled fusion, he said, research now seemed "to be entirely devoid of secrecy."

Thermonuclear reactions — or at least experiments aimed at obtaining enough knowledge of fully ionized gases (or plasmas) at high temperatures so that controlled fusion can be achieved in the future — were a topic of major interest at the conference. Complex devices being used in these studies occupied a large part of the governmental exhibits, and six sessions of the conference were devoted to theoretical or experimental work in this field.

In all this work, it is evident that two major approaches have been followed in all the countries doing research. First is the "pinch effect" in which a large current through a gas causes magnetic fields that constrict it, raise its temperature, and turn it into a plasma. In this approach, the problem is to prevent the pinch from destroying itself, and machines with complicated electromagnetic systems have been developed.

In the second, magnetic mirrors can be used to contain a plasma which has been pre-heated and whose temperature is then increased by collisions of the plasma particles within the magnetic fields.

Although temperatures of over a million degrees have been reported for both approaches, no one has yet been able to claim with certainty that thermonuclear reactions have been achieved. However, improved measurement techniques are providing more and more information about what happens in a plasma, and speakers expressed confidence that thermonuclear reactions would be achieved in the near future.

Actual production of sustained controlled thermonuclear reactions that yield more power than is needed to run the machines producing them lies much further in the future, most experts at the conference agreed. No estimates of the time needed have been shorter than 10 years, and some have been as high as 50.

As for production of usable amounts of power, all opinions indicate that this is far in the future and that fission will be the only source of nuclear energy for many years to come.

FISSION REACTORS PLANNED

Development of large power stations with a wide variety of reactor designs was described in sessions on fission reactors.

Reports indicated that power stations now operating in the USSR, the United Kingdom, and the United States had been "well-behaved," with less difficulty than anticipated at the 1955 conference, as Sir John Cockcroft noted in his summary of the session.

For the future, plans were outlined for large nuclear plants in Belgium, Canada, Czechoslovakia, France, Italy, Switzerland, the USSR, the United Kingdom, and the United States. They will include, for example, a 500,000-kilowatt station at Hinkley Point (UK); a 180,000-kw. station south of Chicago (USA), and a 600,000-kw. station in Siberia informally described at a press conference.

Reviewing reactor designs presented, Sir John noted that graphite-moderated and heavy-water-moderated reactors would have the lowest fuel costs. Boiling-water reactors seemed to be growing in favour because of small size and comparative simplicity; the organic-moderated reactor was attractive because of its non-corrosive, non-radioactive coolant; high-temperature gas-cooled reactors using ceramic fuels might prove important for propulsion as well as land use; and experiments with fluid-fueled reactors and sodium-cooled types were providing important information.

As a means of using the world's supply of fissionable materials to best advantage, several speakers advocated fast breeder reactors. Power breeders under construction in the USSR, UK and USA were described.

Development of methods to utilize the plutonium formed as a by-product in most uranium reactors was described as another means of conserving nuclear fuel. Thorium may well be coming into use by the late 1960's, and plans for the first large-scale power plant to use thorium (in the USA) were cited.

Estimates of the world's uranium reserves were two to four times higher than those presented in 1955. High-grade uranium reserves might total some 10,000,000 tons, and world thorium reserves seem likely to be at least 500,000 tons.

New developments in the complex process of separating fissionable uranium-235 from the more abundant U-238 were described by a number of countries. They compared, for example, the gaseous diffusion process, separation by "nozzle" equipment, and centrifugal separation techniques.

USE OF ISOTOPES

In sessions reviewing applications of isotopes, reports described use of tritium (radioactive hydrogen) as a new tool in biological and physiological research. It is a "soft beta emitter" with a half-life of 12½ days. When injected into living processes it can be assimilated in the cells, and its presence recorded photographically. Accounts were given of tritium investigations on the nucleic acids.

Reports on the use of radioactive chemicals in the treatment of disease indicated that the outstanding advantage still remains the use of radioactive iodine which lodges in the thyroid and produces internal radiation for the treatment of that gland; other radioactive elements do not lodge with the same precision in the appropriate organs or with the same measurable results, and it was emphasized that this was a question of refinement of techniques.

The detection and treatment of brain tumors was also reviewed. Here the search is for materials which will concentrate in those tissues of the brain about which the diagnostician is seeking information and, when irradiated from an external source, will give off rays showing the exact location of the tumor or lesion.

Radioisotopes in medicine are no longer novelties, although Dr. R. H. Chamberlain, of Pennsylvania University, warned against indulging in their use merely because they are fashionable. They have now become precision instruments. For example, as described at the Conference, it is now possible to take "slow-motion pictures" of living processes by injecting radioistopes into experimental animals, instantly deep-freezing them in liquid nitrogen at fixed intervals and thus obtaining photographic records of each stage of the process.

WASTE DISPOSAL PROBLEM

The disposal of wastes from present peaceful uses of atomic energy did not constitute a danger, speakers agreed. However, when fission reactors come into widespread use throughout the world, their radioactive "sewage" might produce a dumping problem. The Chairman of the session on that topic, Alexander Goldberg (Israel), commented that tombs of radioactive waste were becoming as elaborate and as expensive as those of the mummies of ancient kings.

Confidence was expressed that methods now being developed for the solid containment of dangerous atomic by-products (in glass, in concrete, and in beads) for burial could be safe and effective. A Canadian report estimated that the cost of storing wastes in glass would be an unimportant percentage of the price of commercial electricity.

Concern was expressed about the possible large-scale dumping of nuclear wastes in the seas, by speakers from the USSR and the United States, but the consensus was that disposal up to now had been within safety limits.

FUNDAMENTAL PHYSICS

In fundamental physics, highlight of the conference was the presentation by scientists from CERN (European Center for Nuclear Research) of experimental results confirming the direct decay of the pi meson into an electron. This reaction had been predicted theoretically 23 years ago, but it was not until now that the theory could be substantiated.

Almost the entire range of fundamental physics, ranging from "strange particles" to theories of interactions within the nucleus of the atom, was considered at various sessions. In his summary, Sir John Cockcroft spoke, for example, of the "enormous amount of new data" from cosmic ray workers, and a "wealth of new knowledge" produced by atom-smashing accelerators.

GENERAL

The Conference included general sessions on comprehensive subjects, technical sessions or more detailed topics, informal meetings of scientists on problems of special current interest, evening lectures open to the public, and a series of films, as well as the scientific exhibition.

The 2,135 papers came from the following 48 governments and six organizations: Argentina, Australia, Austria, Belgium, Brazil, Burma, Byelorussia, Canada, Chile, China, Cuba, Czechoslovakia, Denmark, Finland, France, German Federal Republic, Greece, Hungary, India, Iraq, Ireland, Israel, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Pakistan, Philippines, Poland, Portugal, Romania, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, Union of South Africa, USSR, United Arab Republic, United Kingdom, United States, Uruguay, Venezuela, Vietnam, Yugoslavia; United Nations, International Atomic Energy Agency, International Labor Organization, World Health Organization, International Bank for Reconstruction and Development, World Meteorological Organization.

Speakers presented 711 of the papers orally, individually or in panel discussions, and the others will appear in the printed proceedings.

Exhibits were provided by Argentina, Belgium, Canada, Czechoslovakia, Denmark, France, the German Federal Republic, Hungary, India, Italy, Japan, Norway, Spain, Sweden, Switzerland, Union of South Africa, USSR, United Kingdom, United States, Venezuela, CERN, and the Joint Institute for Nuclear Research at Dubna, USSR.

The formal conference proceedings, together with the press briefings, were recorded on 21 million feet of tape for later use and reference.

In addition, the full 1958 Conference Proceedings will be published in 33 volumes, compared with the 16 volumes required for the 1955 conference. The first one or two volumes will go on sale in November, and publication is expected to be completed by mid-1959.

The conference was planned by the UN's seven-nation Advisory Committee on the Peaceful Uses of Atomic Energy, which is composed of scientists named by the governments of Brazil, Canada, France, India, the USSR, the United Kingdom and the United States, with Secretary-General Dag Hammarskjold presiding.

ANNUAL

MEETING

1959

TORONTO

Royal York Hotel

8, 9, 10, June

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

St. Lawrence Seaway and Power Project

Seaway Progress

A ceremony was held on September 5 at the international power-house where it crosses the international boundary, to dedicate the new hydro-electric plant, and to mark its official opening. Premier Leslie Frost of Ontario and Governor Averill Harriman of New York State jointly pressed a switch to start eight generators delivering power on a commercial basis, and to illuminate huge figures of "Uncle Sam" and a Canadian "Mountie".

A crowd of some 1,200 Canadians and Americans heard addresses by Ontario Hydro chairman, James Duncan, New York State Power Authority chairman, Robert Moses, and former New York Governor, Thomas E. Dewey.

Weather during August was favourable, though with many contracts completed or nearing completion the total force employed was reduced to an average of some 10,000 persons during the month. Early in September, five units on the Canadian side of the power-house and six units on the American side were in operation intermittently, supplying secondary power. Installation of the remaining units was progressing, with expectation that one new unit on each half of the power-house would be readied for operation about every six weeks.

Progress by Ontario Hydro

Placing of concrete on the Canadian half of the power-house had reached about 98½ per cent of completion, with some 15,000 cubic yards yet to pour in various places. Dredging was continued on upstream channels at two sections. Dredging of the tailrace on the Canadian side will not be commenced until next year. Average employment for month of August was 2,200 persons.

Progress by NYSPA

Placing of concrete on the American half of the power-house stood at about 98 per cent of completion with some 20,000 cubic yards still to place in various locations. Work was proceeding on building a cofferdam for excavation of the tailrace area. The first half of this cofferdam will be enclosed and ready for pumping by mid-September. Two dredges were working on the south Cornwall channel.

On the Long Sault dam, the last of the concrete was being placed in the tunnels through the spillway. Twelve of the gantry-operated gates and six of the hoist-operated gates were completed and in service. Average employment during the month of August was 2,500 persons, down 300 from the previous month.

Progress by SLSDC

With lock approaches completed and the two American locks operating satisfactorily, dredging continued downstream and near the new high-level highway bridge. On the bridge, erection of steel was completed for the main suspension span and a start had been made on placing concrete on the roadway deck. Employment during the month of August had dropped to about 400 persons.

Progress by SLSA

By the end of August, water had been let in over the entire length of the seaway navigation channel between Montreal harbour and Lake St. Louis. All concrete had been placed on all Canadian locks with exception of short lengths of the upper approach wall to the lower Beauharnois lock and lower approach wall to the upper Beauharnois lock.

At the St. Lambert and Côte Ste. Catherine locks, gates were installed but not tested, while installation of gate machinery was proceeding. On the two Beauharnois locks gates were in position but installation of gate machinery had not proceeded very far. There still remained considerable excavation of the channel to complete between the two Beauharnois locks, while above the upper lock and below the lower lock preparations were underway to permit sinking in place of seven and twelve precast concrete cribs respectively in the channel upstream and in the basin below in Lake St. Louis. Target date for completion of all four locks is the end of November.

On the Welland canal, excavation had been completed between locks 1 and 4. There was still some work proceeding at Port Colborne, Port Weller, Thorold and in the Welland area.

Bridges

Only work remaining at end of August on the Jacques Cartier bridge was to pour concrete around the permanent piers supporting the span over the seaway channel. The National Harbours Board will call for tenders in September for an additional traffic lane to ease congestion on the bridge.

At Victoria bridge, the lift span over the St. Lambert lock had been completed except for electrical installations. The roadbed for the highway diversion on the upstream side was expected to be in place by March 1959, but trains will continue to use the straight course across the bridge and will wait while the lift is up until 1960, at which time the steel work for the rail part of the diversion will be completed.

At the Mercier highway bridge the four-lane section leading to the south shore was completed and traffic was running over one of the three high-level approaches. Cars were using the 'east abutment' which carries traffic towards Laprairie. Traffic to Malone and Valleyfield was also using this approach until the first of two approaches for these routes is finished by end of October. The third approach will be a two-lane ramp leading to Valleyfield which will not be completed until February. The Quebec Roads Department was building half a mile of permanent highway leading to Laprairie from the south approach to the Mercier bridge.

At the CPR-NYC Caughnawaga rail bridge the new lift span was in service across the seaway channel.

Employment on all phases of the Canadian navigation project during the month of August averaged 5,300 persons.

Other Seaway News

The City of Cornwall, as part of a master plan to serve the needs of industry, has planned a harbour for ocean vessels on the east side of the city. A total of 11,500 feet of wharfage will provide berths for 15 ships at one time. There will be offloading and storage facilities for bulk shipments on Pilon Island which will be connected with the mainland by a lift-bridge causeway. The harbour is planned for eventual handling of 4 million tons of freight yearly. The city has set aside 300 acres of serviced land with a further 900 acres reserved.

Missiles for Canadian Defence

"Although the *Arrow* aircraft and the *Iroquois* engine appear now to be likely to be better than any alternatives expected to be ready by 1961, it is questionable whether in any event their margin of superiority is worth the very high cost of producing them by reason of the relatively small numbers likely to be required", Prime Minister Diefenbaker announced on September 23, 1958.

These and other reasons prompted the decision against putting the Canadian supersonic interceptor CF-105 into production. The *Bomarc* guided missile will be introduced into the Canadian air defence system.

The *Bomarc* is a long-range anti-aircraft missile guided from the ground. The control system is the S A G E (semi-automatic ground environment).

The Avro Arrow project began in 1953. Subsequent missile developments alter the conditions anticipated when the aircraft would come into use in the 1960's. The conclusion is that manned aircraft, however outstanding, will be less effective in meeting the conditions than previously expected.

Related decisions reported by the Prime Minister are these:

Two Canadian bases for firing the *Bomarc* missiles will be established in the northern Ontario and Quebec areas.

Pinetree radar control system will be augmented by several large stations and a number of small intervening stations.

SAGE electronic control and computing equipment will be installed into the Canadian air defence system.

Missile and aircraft defence will be on an integrated North American basis under NORAD operational control.

The *Arrow* aircraft and *Iroquois* engine development program will continue until next March, when the situation will be reviewed. (One hundred *Arrows* are to be built, according to a news report.)

Development programs for the *Astra* flight and fire control system, and the *Sparrow* air to air missile being developed for the *Arrow* were cancelled. Modification of the *Arrow* during its continued development will permit the use of a system and weapon already in production.

Canadian work in the design, development and production of defence equipment will have to be closely integrated with the major programs of the U.S.

Negotiations are under way for Canadian industry to share in the production programs for the missiles, associated equipment and electronic computers.

Ontario Highway Program

Extensive additions being planned for Ontario's highway program were announced by the Premier in August.

An expenditure of some $100 million is proposed, in addition to the record program already under way.

The policy of the Government was then announced as follows:

1. To co-operate with the State of New York and the State of Michigan in building international bridges and approaches at Queenston and Sault Ste. Marie on which tolls will be charged.
2. To proceed with a new entrance to the Niagara Parks System particularly from Queenston to Niagara Falls.
3. To erect skyways at three points on the Welland Canal—at Homer, near St. Catharines, and in the Welland and Port Colborne areas. These skyways will be tolled.
4. To complete the Causeway over Rainy Lake, east of Fort Frances, and extend Highway 120 westward from Atikokan. The causeway will be tolled. These roads will give further access to the Quetico Park area and will link the Trans-Canada Highway with the Mississippi Parkway now under development in the U.S.
5. To construct the Chedoke Expressway in Hamilton as a provincial project which will greatly relieve traffic conditions in that area.
6. To extend the road from Port Colborne to Welland on through Fonthill to St. Catharines to connect with the Queen Elizabeth Way.
7. To rush Highway 401 through to completion ahead of schedule as well as the Ontario Section of the Trans-Canada Highway.

Tolling of certain roads is a new policy, it was reported, a new method of financing these extraordinary works. Where tolls are charged on skyways, the province will maintain and improve existing facilities and at Burlington a new low-level, toll-free bridge is to be constructed.

Completion and formal opening of the Burlington Bay Skyway was expected in the late fall.

Study of Rivers

Canadian scientists are cooperating in a world study which may reveal the part rivers play in the incessant disintegration of the continents.

Scientists estimate that every second over 250 million gallons of fresh water flow from the 65 rivers under study on six continents, carrying with it, in addition to silt and suspended material, an undetermined quantity of dissolved solids such as salts and other minerals. It is these soluble solids, estimated to be pouring into the ocean at the rate of 450,000 tons an hour, that Canadian and world scientists will study.

The Industrial Minerals Division, Mines and Technical Surveys, is undertaking Canada's share of the fundamental research program. Five sampling stations are operating at suitable sites near the mouths of the Fraser, Mackenzie, Churchill, Nelson and St. Lawrence rivers.

The International Association of Scientific Hydrology organized the world run-off program in which over thirty countries are participating.

Development of Education in Engineering at the University of Alberta

A Report on Growth in the Engineering Faculties in Canada

Ninth article of a series

The Faculty of Engineering at the University of Alberta offers a four-year undergraduate course leading to the B.Sc. degree in chemical, civil, electrical, metallurgical, mining, and petroleum engineering. Degree courses in engineering physics and engineering geology are offered to students with high academic records, and a combined course leading to the degree of B.A., B.Sc. may be arranged. Graduate work is offered leading to the M.Sc. and under some circumstances to the Ph.D. degree.

Physical Plant

The physical expansion of engineering facilities has followed the rapid increase in trained engineering personnel required by an expanding industrial economy. In September 1953, the four-storey, brickfaced, reinforced concrete engineering building was opened, which provided a gross area of 68,000 sq. ft. of laboratory, research, and classroom space.

There have since been continual improvements in use of physical plant, as well as additions to and alterations of facilities.

The establishment of the degree of metallurgical engineering required the installation of carefully designed teaching and research laboratory facilities and an addition to the building this summer allows approximately 1.600 sq. ft. expansion for the metallurgical section.

Student enrolment is necessitating the growth of the physical plant and is resulting in improved facilities for departments that provide basic courses for engineering.

Three new projects that are in the design stage with construction anticipated to begin during the fall of 1958 are: (a) the Physical Education Center which will provide offices, lecture rooms and gymnasia space for the School of Physical Education. Incorporated with this project will be a swimming pool and rink that will be equipped with an all-purpose floor and have an artificial ice plant. The estimated cost of this project is $2,-600,000. (b) The Physics, Mathematics, Chemistry Center is the major project under design and will consist of a six-storey building for the Mathematics and Physics Departments, and a five-storey building for the Chemistry Department. The two buildings are to be joined at the lower level and a lecture wing containing 14 tiered lecture theatres will be shared. These departments provide service courses for the Engineering Faculty. The Center will have a gross area of 300,000 sq. ft. and an estimated cost of $7,000,000. (c) the $2,750,000 addition to the Medical Building will consist of a seven-storey building having a gross area of 130,000 square feet.

Courses and Curricula

The addition and revision of courses has followed the advance of engineering knowledge. The traditional courses in civil, chemical, electrical and mining engineering had not sufficiently covered the specialized requirements of modern developments. The growth of the petro-chemical industry necessitated the establishment of a degree course in petroleum engineering in 1948.

In 1956 a degree course in physical metallurgy was established which deals with the properties, structure, and fabrication of metals and alloys. Emphasis is placed upon the recent advances in structural metallurgy.

In 1957 first year engineering program was offered at the Calgary Branch of the University of Alberta. A new campus site has been obtained at Calgary and Stage 1 of the building program will provide facilities for 150 first year students and 100 second year students.

Students are showing an increased interest in the engineering-physics pattern and courses are available in the field of interest of the student and programs in the fields of aeronautics or fluid mechanics, atomic or nuclear physics, electronics, and geophysics, have been arranged.

The faculty has embarked on a revision of the engineering curricula to enable recent developments in engineering to be included in a four-year program. The courses are being studied to eliminate unnecessary duplication of content, to introduce new material and, if necessary to adjust the lecture hours. Changes have been introduced into first and second year programs and a review of the third and fourth year programs is anticipated.

The first year engineering term is being lengthened by approximately two weeks. The basic changes in first-year engineering are an increase in the hours of the chemistry course; combining of drawing and descriptive geometry into a single course and extending the surveying course from half-term to full-term. Survey field work in the second year program will be replaced by four weeks of survey field work at the end of the first year. The faculty is also proposing that a three-hour English course be introduced into the first-year.

The changes in second year involve the introduction of a new course entitled "General Astronomy" which will make the student aware of the problems of the modern age, the problems of map making and map usage, and space exploration.

Special courses that have been introduced into second year are: (a) Graphics 2, which is taken by civil engineering students, will be a continuation of the first year drawing and descriptive geometry course with extension to other aspects of civil engineering. (b) A quantitative analysis and a physical chemistry course will be given to chemical, petroleum and metallurgical engineering students. (c) Electrical engineering students will take a course in the principles of circuitry which will illustrate types of circuits; Ohm's and Kirchoff's Laws; the effect of inductance, resistance, and capacitance, and general solutions of networks.

The purpose of these courses is to permit a more rapid advancement of the student in his area of study during third and fourth year.

Graduate Studies and Research

For the past six years the Department of Mining and Metallurgy has carried out a research project on heavy media concentration (hydrocyclone concentration) which has been sponsored by the Atomic Energy Control Board and Eldorado Mining and Refining Company Limited. A research project in hydro-metallurgy, sponsored by these same organizations, has just begun, and deals with the application of activated carbon to uranium recovery from leach liquors.

In physical metallurgy, research projects are sponsored by the Defence Research Board, Consolidated Mining and Smelting Company and International Nickel Company. These research projects have led to an active research section comprising five masters students, a research associate and a post-doctorate N.R.C. fellow.

The research projects in physical metallurgy are generally concerned with the constitution of alloys and its relationship to their mechanical properties.

Equipment bought from various research funds and university funds in extraction metallurgy include special heavy media and flotation equipment, analytical equipment, microscopes and grinding equipment; in physical metallurgy, x-ray diffraction, high frequency generator, hot stage microscope, mechanical testing equipment, arc melting unit.

In mining, the Department is co-operating with the Fuels Division of the Department of Mines and Technical Surveys on a field research project dealing with outbursts in coal mines in Alberta.

In 1957 a program involving post-graduate work in highway engineering and research projects in co-operation with the Department of Highways of Alberta, Alberta Research Council, and the highway industries was begun. This program includes traffic and safety engineering, advanced soil mechanics and soil testing, design and control of asphalt and concrete pavements, and river hydraulics. Three annual $2,000 scholarships for this program are provided by Westeel Products Ltd., Union Tractor Ltd., and Standard Gravel and Surfacing of Canada Ltd.

In 1957 there were twenty-five M.Sc. candidates in civil engineering and in 1958 a Ph.D. candidate will study in the field of hydraulics and hydrology.

A research program in concrete and concrete materials was undertaken on the properties of aggregates in the Province and a range of concrete mixes was developed suitable for major types of construction in the Province. Subsequently the work was extended into the field of durability of concrete to stand severe exposure conditions. Pioneer work on the usefulness of air entraining agents in concrete was undertaken. The Department recently started a long range investigation on light weight concrete.

In co-operation with the Division of Building Research of N.R.C., a comprehensive study of foundation conditions in the Edmonton area was undertaken. This established the existence of highly plastic preconsolidated clays which are capable of exerting substantial swelling pressures if overburden pressure is removed and if free water is available to the soil.

In recent years, graduate work in chemical engineering has been primarily concerned with fluid flow, the utilization of natural gas, and the phase behavior of hydrocarbon systems.

The work on fluid flow has been related to studies of the characteristics of two-phase flow in pipes and on the rheology of non-Newtonian fluid systems. Two phase flow studies have been made for the air-water system flowing vertically, and for oil-water and clay-water systems flowing horizontally. This work has largely been sponsored by the National Research Council of Canada. Extensive work has been done on the flow characteristics of several Alberta crude oils, initially under the sponsorship of the Interprovincial Pipeline Company and more recently of the National Research Council. A great deal of work relating to the viscosimetry of non-Newtonian fluid systems in general has been done.

The work on the utilization of natural gas has been carried out jointly by the Department and the Research Council of Alberta. Attention has been focused on the utilization of methane, propane, and butane. Studies were initiated in 1949 on the production of carbon black from methane by the Pidgeon Process, and on the production of organic chemicals from the partial oxidation of butane. More recently studies have been focused on optimum equipment and conditions for the production of unsaturated hydrocarbons from propane and butane.

Studies on the phase behavior of hydrocarbon systems was initiated in 1955 with an investigation of the phase behavior of natural gas containing relatively high concentrations of hydrogen sulphide and carbon dimide. At the present time the volumetric behavior of the same system is being studied. Work is also being done on the hydrate forming conditions in mixtures of saturated and unsaturated hydrocarbons. The studies are sponsored by N.R.C.

In order to understand and solve many of the problems of primary and secondary petroleum production from a reservoir, a program in fundamental petroleum research was initiated in the Department of Chemical and Petroleum Engineering. This project includes the examination and study of the fundamental concepts and physical principles underlying the mechanics of oil production. Work has been started on two phases of this project; 1. miscible fluid displacement and 2. the effect of initial rock conditions on the ultimate recovery of oil by gas or water drive.

The work is at present in its infancy and has primarily been concerned with literature studies and construction and development of equipment.

The work is under the sponsorship of the petroleum industry, University, and Research Council of Alberta.

Graduate student enrolment in the department has increased from one in 1947 to about twenty-four at the present time. Of these, two are working toward a Ph.D. degree. In the same period about twenty-five master's degrees have been awarded.

Graduate courses in the Department of Electrical Engineering may be arranged in the fields of high frequency communications, V.H.F. and U.H.F. communications, microwave equipment, modern power transmission engineering, corona phenomena and precision instruments. Four masters candidates were registered last year.

An electronic analogue computer has been built for studies in servomechanism circuits and a new course entitled "Principles of Servo-Mechanisms" has been introduced.

Modern equipment for study of recent developments in communications and electronics has been purchased and electric dynamometer equipment has been added to the power laboratory. The range of the impulse generator has been extended to 400,000 volts.

Other Facilities

At present a degree course in mechanical engineering is not offered but basic courses in thermodynamics, machine design, and the performance and testing of equipment are given by the mechanical engineering staff.

Engineering and Science Building, University of Sherbrooke.

Facilities are available for the performance testing of gasoline and diesel engines, steam engines and small steam turbines, air compressors, fans, and refrigeration units.

Recent equipment additions are a 4-cylinder model 180 G. L. Waukesha gasoline industrial engine, a gas fired superheater and a model 1551A sound level meter. An Orenda jet engine to be used for demonstration purposes has been donated by the Royal Canadian Air Force.

Through the generosity of the English Electric Co. and the Provincial Department of Public Works, an English Electric Model 27 Gas Turbine and Alternator is being provided for student testing. This 2,200 K.W. unit complete with regenerator, waste heat boiler, and educational panel is being housed in a specially designed, acoustic treated building.

An L.P.G. 30 digital computer has been purchased for the university and is available for use to interested departments.

Engineering Education Progress at the University of Sherbrooke

The Faculty of Science of the University of Sherbrooke traces its origin to 1951 when the Catholic School Commission of Sherbrooke undertook to create a first year of Engineering at the Ecole Superieure de Sherbrooke, directed by the Brothers of the Sacred Heart. This was the logical continuation of a 13th grade (scientific) known as Senior Matriculation, which had already been given since 1945.

In September of 1954, year of the foundation of the University of Sherbrooke, its second year of Engineering was inaugurated. 1956 and 1957 saw the addition of the third and fourth years. The program for the Fifth year is now complete and has started this fall (1958). The first convocation will be held in the spring of 1959.

Curriculum

The curriculum, leading to the degree of bachelor in applied sciences, consists of a five-year course. The first three years are mainly devoted to basic chemistry, physics and mathematics. With the third and fourth year, which are common to all branches, begins the study of engineering topics: hydraulics, machine design, thermodynamics, strength of materials, electrical engineering, geology. The student may choose one of the three following options in his fifth year: Civil, Mechanical and Electrical. The curriculum is perhaps not quite as specialized as that offered by other universities. A survey of the regional employers seems to indicate that a broad scientific training was more desirable at the present time. The course has been approved by the Board of Examiners of the Corporation of Professional Engineers of the Province of Quebec.

Physical Facilities

The grounds of the university's campus are situated 3 miles southwest of down-town Sherbrooke and

Strength of materials laboratory, Sherbrooke: a flexure test with universal testing machine.

Electrical engineering laboratory, Sherbrooke: study of wave shape of an a-c generator.

cover an area of around 500 acres. A grant from the Quebec Provincial Government permitted construction in 1956 of the Engineering Building, the first building to be erected on the new university's campus. A fund-raising campaign is in progress for the university. It seeks $4 million with which to build an adjunct to its present Engineering and Science Building at a cost of $1.25 million; four other buildings and campus services plus landscaping make up the objective. Long-range plans call for still more buildings, further extensions of engineering, science and the other faculties, to create a major university.

Distribution of space to various departments, Engineering building.

	sq. ft.
Chemistry lab.	3,000
Physics lab.	3,300
Hydraulics lab.	3,200
Strength of Materials lab.	2,500
Electrical Engineering lab.	2,400
Biology lab.	1,100
Electronics lab.	1,600
Thermodynamics lab.	2,700
Soil Mechanics lab.	1,300
Mineralogy	1,100
Cafeteria	2,500
Library	3,600
Classrooms	11,000
Drafting room	3,600
Auditorium	4,500

Present premises are designed to hold some 450 students. Registration stood at 250 during the year 1957-58. It is expected that the fall enrolment will boost that figure to over 300. Provisions have been made for expansion and it is expected that still more facilities will have to be provided within ten years.

Essex College, Windsor, Offers Engineering Education

To report the progress of engineering education at Essex College, of Assumption University, Windsor, Ont., the *Journal* abstracts here a recent brochure of the College, which is available from the registrar.

Essex College was incorporated by the Province of Ontario in 1954, as a non-denominational college with the power to provide training in the sciences and other fields of higher education. It was affiliated with Assumption University of Windsor.

In a legal sense, Essex College is a corporation whose membership is composed of distinguished leaders of local industry and business. It is governed by a board of directors which plays an active role in planning and guiding the College's progress, particularly in the financial and physical aspects.

The faculty, within its departments and committees which enjoy representation on the University Senate and other governing bodies, charts the academic course of the College. Its primary responsibility is to instruct the students in the principles and concepts which give the graduate professional competence combined with a sense of humanistic values which extend beyond specialized interests.

Essex College is on the Assumption University campus, close to the Detroit River. Dillon Hall (the Arts building) and Essex College are situated near the new University Library which will be completed this fall. The University Union, proposed for 1959, will occupy a central position on the campus. To the south is St Denis Hall, one of the largest gymnasiums in Canada. The historic buildings housing residences, administration, and chapel are on the west side of the campus.

Applied Sciences, Business Administration and Fine Arts buildings are scheduled for construction at a later date. There is also an Engineering Building in the plans.

Development of Engineering

For more than 25 years, Assumption has been teaching two years of pre-engineering beyond Grade XII. When Essex College affiliated in 1956, it assumed the responsibility of instruction in this field. A special committee of the board of directors was set up to establish whether or not the University might establish a complete accredited program leading to the bachelor degree in four branches, chemical, civil, electrical, and mechanical engineering.

The committee conducted surveys among industrial corporations to determine the demand for engineering graduates in the next five years and among high-school students to determine the potential enrolment. The Committee then recommended that in 1957 Essex College should offer the first full year of the full program. Second, third and fourth years would be added in consecutive years.

Several types of plans, including the co-operative and the quarter system, were considered, but the final decision strongly favoured the conventional four - year - beyond - Grade-XIII Canadian type of plan. The surveys conducted among industrial leaders and potential students indicated that this plan best serves the needs of that area and that province. The concentrated period of instruction makes possible the integration of the program with established courses. The long summer vacation period enables the students to gain practical experience and to support themselves financially, and gives the staff an opportunity to pursue study and research programs.

The engineering development committees are continuing their meetings in a constant effort to improve and modernize the plans from year to year. Courses in other branches of engineering will be offered as the demand for them becomes apparent.

The Curriculum

The curriculum is the result of extensive planning in consultation with engineering educators in Canada and the United States. It combines the recommendations made by the American Society for Engineering Education for a "broad base" of studies in the arts and social sciences with the high level of technical content so necessary for accreditation and for the professional competence of the graduate.

A feature of the engineering curriculum at Essex is its arrangement in a manner which facilitates the transfer to other science and arts programs without loss of a year.

The first year is common to all courses, containing: an introduction to philosophy; communication skills; chemistry and qualitative analysis; differential and integral calculus; algebra, geometry, and trigonometry; mechanics, heat and sound; electricity and magnetism; engineering mechanics; drawing and descriptive geometry; surveying.

In the four separate courses, second year, there is a common program in the philosophy of science, ethics or theology, intermediate calculus and differential equations, strength of materials. The rest of each course is concerned with the science of electrical, civil, chemical or mechanical engineering. The third and fourth years will advance the student to technical competence, while also offering work in history, social philosophy, humanities, law and economics.

Essex College's academic policy is based on the concept that every graduate should have a solid grasp of the humanities as well as of the techniques of his profession. This policy was outlined by W. H. Arison, chairman of the Board of Directors.

The foremost objective of the College is to attain the highest academic standards possible. This involves the acquisition and development of top-grade instructional staff and the provision of the necessary physical facilities for study and for research. Because pure and applied science teaching of the highest type thrives best when it is intimately associated with creative work, original research is encouraged and supported.

Dr. F. A. De Marco, chairman of the Staff Committee, describes the Essex attitude in these words: "We are primarily concerned with the individual. When classes become so large that a close student-professor relationship is impossible, the quality of instruction is bound to be inferior. At Essex College we are designing our classrooms, laboratories, and methods of instruction to allow for maximum contact between the individual student and the members of the faculty".

Changes in Engineering Curriculum Ecole Polytechnique, Montreal

L'Ecole Polytechnique, which is the faculty of engineering of the University of Montreal (see first article of this series, *Engineering Journal,* January 1958, Page 89) has been offering since last January to its third year engineering students a new curriculum leading to the full specialization course. The fields of engineering offered to them are eight in number: civil, mechanical, electrical, mining, metallurgical and geological, and also engineering physics.

Although the university has for many years been operating with departments assigned to each of these fields, except engineering physics, the degree was of a semi-specialized character. The optional courses which are still in effect for the graduates of next year, have been split into the corresponding specialized branches of engineering, thereby allowing the granting of the fully specialized degree.

The engineering physics course is being introduced for the first time. At the bachelor's degree level, it will give emphasis to subjects related to electronics and will include a first course in atomic physics and nuclear engineering.

General training in the field of applied science was the chosen method of Ecole Polytechnique up to 1941. Then the curriculum leading to the bachelor's degree was common to all students. The first degrees of the semi-specialized course were granted in 1943. There has been constant evolution and changes, as introduced, generally increased the content of the specialized subjects.

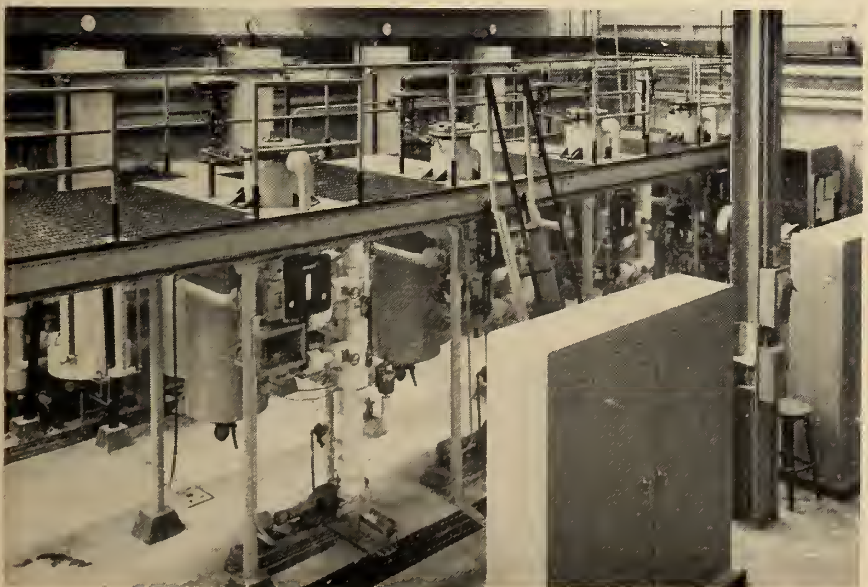
In establishing the fully specialized degree Ecole Polytechnique does not, according to Dean Henri Gaudefroy, reject the principle which has served as a guide in the past. The curriculum has practically been left unchanged in the first years of the course, where the fundamental sciences are taught. Of the total time in the five-year course, 41 per cent is still assigned to the basic science subjects; 21 per cent of the time is spent at the level of the straight engineering courses on applied science subjects not related to the specialized field, and 30 per cent is fully spent in specialized topics; the balance of 8 per cent is used to cover humanistic and social sciences.

New Building Occupied This Fall

Ecole Polytechnique is occupying its new quarters which provide approximately twice as much space as the old location. This permits a very timely expansion of the facilities, which will allow the introduction of new subjects.

This expansion will mainly take place at the level of the last two years of the course, and also at the graduate level leading to the degrees of master and doctor of applied science.

Chemical pulping laboratory, Pulp and Paper Research Institute



Pulp and Paper Research Centre

Effective partnership of industry, government and university is demonstrated by the existence of the new laboratory of the Pulp and Paper Research Institute of Canada. (illustrated in *Engineering Journal,* September 1958, Page 112).

In the new building at Point Claire, Que., the Institute will continue its function as a fundamental research centre for Canada's pulp and paper industry.

It stimulates and assists in the post-graduate training of McGill University students who are working toward higher degrees in science and engineering, those particularly whose theses deal with subjects of interest to the industry.

The institute's research operations may reach into any aspect of the process of converting cellulosic plant materials into pulp and paper and other products.

The new laboratories were built and equipped to the Institute's specifications by the Federal Government at a cost of two and a quarter million dollars. Some of the furnishings and about half a million dollars' worth of apparatus and equipment were provided by the industry.

Canadian Pipeline Projects

Westcoast Transmission Company Limited

The extension of Westcoast Transmission Company Limited's natural gas gathering system northwest of Fort St. John has been completed ahead of schedule. Testing of the 84-mile extension, which roughly follows the route of the Alaska Highway, was finished August 16, and it will go into operation in September. More than 300 men, 90 per cent of them Canadians, were employed on the project at peak periods.

When 21 new gas wells are all tied late in 1958, an estimated 80 million cubic feet a day more gas from B.C. fields will be delivered to the McMahon Plant at Taylor, which processes the sour gas into motor fuels, sulphur and residue pipeline gas. Ultimately, the extension will add 150 million c.f.d. to the gathering system's capacity.

First shipment of several carloads of sulphur was shipped from Taylor, B.C. on August 4 to three paper mills on the Pacific coast of B.C. Supplier was Jefferson Lake Petrochemicals of Canada Ltd., from its new $2¼ million plant which processes 425 tons of sulphur daily from Westcoast's gas processing plant at Taylor. This company plans other sulphur manufacturing plants at Calgary and Coleman for exports to Australia, Japan, Korea and India.

Inland Natural Gas: A contract was signed late in August between Consolidated Mining and Smelting Co. and Inland, for five million cubic feet of natural gas daily for the Company's Trail, B.C., smelter. There will be cuts in consumption of fuel oil, coal and coke but the use of these fuels will be continued in many phases. Installation of mains has started and consumption should commence in October.

Alberta Gas Trunk Line: Construction was completed during August on the Company's 1958 program of extensions and new laterals, including the 145 miles of 24-inch line from the Pincher Creek Field to junction with 34-inch main line near Princess, Alberta.

Canadian Western Natural Gas: Progress on the $2.8 million 58-mile 16-inch gas pipeline from the Carbon field to Calgary had reached the halfway mark by mid-August. The $220,000 gathering system soon to be started will furnish a supplementary supply of 150 MMcfd to the Calgary distribution system.

Trans Canada Pipelines

Construction of the final link of the Trans Canada Pipeline from Lakehead to Toronto was reported to be on schedule at the end of August, to meet the November 1 completion date.

Trans Canada reported at end of August that construction crews on the 853-mile link between Kapuskasing and Toronto were entering the most difficult stages through rock and tough muskeg country. Special methods had to be devised by contractors for overcoming what sometimes appeared to be bottomless mire. Nevertheless on both this section and on the Northern Ontario Pipeline Crown Corporation section from Port Arthur to Kapuskasing, all right-of-way had been cleared and graded and 75 per cent of the pipe had been strung or further processed. As sections are completed east from Port Arthur and north from Toronto the line is being tested.

Winnipeg Central Gas: It appeared by late August that Winnipeg and Central Gas, the existing distributor in Winnipeg, would accept the cut in rates recommended by the Natural Gas Enquiry Commission, of 90 cents per thousand feet average, a reduction from current rate of $1.01 per Mcfd. The utility has about 13,000 residential space heating customers. The report had suggested it should base its expansion program on a build-up of 56,000 such customers by 1962.

Northern Ontario Natural Gas Co. By late August, the Company's $15 million pipeline and distribution program for 1958 had reached the halfway mark, with construction proceeding on schedule. Completion of the big construction job which will bring gas to homes and factories in 32 northern Ontario communities was scheduled for completion by mid-September. Gas will be available to customers in most areas not later than mid-October. Three firms are working on 14 spreads in different sections of the franchise area. Installation of distribution systems was in progress in 17 communities, and starts on 12 other towns were scheduled to begin in late August.

Construction was also proceeding satisfactorily on the 32-mile Timmins lateral and on the 88-mile Sudbury lateral. On the latter, a drilling rig was boring two holes simultaneously through rock, which will be filled with blasting powder and detonated to blast a four-foot pipeline trench 88 miles long from North Bay to Sudbury.

Swan Hills Crude Oil Pipeline: Construction for the 125-mile 10-inch $6.5 million oil pipeline from the Swan Hills field to Edmonton has been awarded by Federated Pipelines to two companies. The northern 40 miles to Fort Assiniboine will be built by Mannix Ltd., while the southern 85 miles will be built by Fulton Bannister, Ltd. Construction was commenced in mid-August with target date for completion November 1. Ultimate maximum capacity will be 40,000 barrels a day. Pipe will be supplied by Alberta Phoenix Tube and Pipe, Ltd.

Extension of Imperial Oil Pipeline Approved: The House of Commons on August 26 approved a bill authorizing extension across Canada of an Imperial Oil franchise held by Stanmount Pipe Line Co., a wholly owned subsidiary. The franchise formerly covered only the provinces of Saskatchewan, Manitoba and Ontario.

What Goes On

Why Build Now?

An editorial under the above title to appear in *Bridge Briefs*, a publication of Dominion Bridge Company Limited, says that savings can be made by going ahead now with plans for new plants or extensions to old plants, new office buildings, new process developments.

"A new boom within a reasonably short period" is to be expected, at which time capacity may be insufficient, the editorial warns. Meanwhile, in general terms, it reports, construction costs are down, and there are these hidden items in favour of building now:

Labour is more productive, and is in adequate supply. Construction materials are plentiful. Contracting firms, are ready to swing into action, at the lowest price consistent with staying in business. Work goes ahead faster, with consequent saving of time and of money both in interest charges and in earlier availability of facilities. Borrowing to finance new construction is cheaper and easier. The machinery market is in a more fluid condition.

The fear of building now might well be exchanged for a greater fear of not building now, say Dominion Bridge.

The company is itself continuing its 20-million expansion and improvement program started two years ago.

Winter Construction

Representatives of the Canadian construction industry attending the National Winter Employment Conference in July, made recommendations to increase employment in the 1958-59 winter season.

Attention was given to incentives, with these and other recommendations:

That the Federal Government offer the incentive of accelerated depreciation (capital cost allowances) to encourage capital investment in winter months.

That the Government use means in the residential construction field such as: increase in number of builder loans to winter builders; removal of restrictions against direct mortgage lending by C.M.H.C. on rental housing projects; and study of increased mortgage valuations and decreased interest rates for winter-build units.

That study be given to expansion of operations of the Industrial Development Bank to make capital investment funds more readily available for wintertime expansion of plant facilities.

The construction industry is capable and ready to work year-round, said A. Turner Bone, past president of C.C.A. recently. It successfully carries out construction under very severe weather conditions at very low temperatures, particularly on the prairies and in the Arctic.

To keep construction going during the four months of winter, timing of the start of the building operation is the most important factor in providing reasonable costs to owners as well as maximum employment.

Port of Toronto

There will be another terminal at the Port of Toronto, to be known as Terminal No. 17. The Chairman of the Port Authority announced this at the formal opening of Terminal No. 15 in May.

This will be the third terminal built for the direct overseas trade during the last four years.

The Mineral Industry

The value of mineral production in Canada in 1957 was more than $2.133 million, according to a bulletin prepared by the Department of Mines and Technical Surveys, for the Brussels Fair exhibit. This figure is exclusive of aluminum, made from imported ore. From domestic resources, 24 metals, 27 industrial minerals, and 3 fuels were produced in commercial quantities, many of them primarily for export to world markets.

Less than half of Canada's 3.8 million square miles has been prospected in any detail, and much of the remainer is known to be favourable for the occurrence of metals, minerals and fuels.

Building Research Notes

Reports from the Building Research Division, of National Research Council, during the past several months recount various activities.

Study of wind action. The Division began a study of the action of wind on structures, with the aim of making the formulation of design wind load requirements more rational and precise and of indicating what further research would be most fruitful.

Working in co-operation with the Meteorological Branch of the Department of Transport, the Division is studying the questions of better statistical interpretation of the prescribed wind velocity, associating it with a certain probability of occurrence; the significance of action of gusts as related to size of structure; variation of wind velocity with height and topographic characteristics; wind velocity in city or countryside.

Studies of damage have already been undertaken. The Division also welcomes advice of unusual damage to structures, attributable to wind.

Loading tests on house roof frames. The Division announced completion of test work on a project it has been conducting for 2½ years. These tests were to determine the strength and deflection characteristics of a number of conventional roof framing systems and trussed rafter constructions.

From these a number of truss designs were developed using either eastern spruce or Douglas fir lumber. The designs, together with designs produced by the Forest Products Laboratories of Canada, have been distributed by Central Mortgage and Housing Corporation.

Building Code Use. The Division reported that 364 municipalities in Canada are using the National Building Code. A report on use of the Code is available from the Secretary of the Associate Committee on the National Building Code, N.R.C.

Fire Research Building. The Division announced the opening in October of the new fire research building of the N.R.C.

The building contains two large furnaces for standard tests and research on the fire resistance properties of walls up to 12 feet square and floors up to 12 by 15 feet, together with the necessary ancillary equipment.

The opening followed a special two-day conference on Fire Prevention and Fire Research.

Pressure Pipe Plant

Anthes Imperial opened a new pressure pipe plant in Calgary, May 30.

It provides highly mechanized facilities for the production of centrifugally spun cast iron pressure pipe.

This product, used for water distribution, and also suitable for gas distribution, takes an important place in current Western Canada expansion, according to commentators on the event.

The company provides products for the petroleum, mining and construction industries, and engineering specialty products.

Calgary Herald, May 30, 1958

New Brunswick Industries

Concrete Plant. The official opening of the new push-button pre-mix concrete plant of Jos. A. Likely, Ltd., at East Saint John, N.B., was celebrated during the summer.

The plant, the first of its kind east of Montreal, is arranged so that one man at a control panel directs mixing from start to finish. Aggregates, water and additives are selected automatically.

This is the latest addition to the product line of the Likely company, a business founded in 1876 to be the agent for several New Brunswick lumber mills.

Wire Mill in Lancaster. Western Wire and Cable Co. Ltd., has a new manufacturing plant at Lancaster, N.B.

The new plant will produce a wide range of industrial and commercial electric wires for both power and communications.

Fifth Convention of the Pan-American Union of Engineers' Associations

Accentuating the harmony which can exist among independent countries, the Union of Pan-American Engineering Associations, commonly known as UPADI, met at the Queen Elizabeth Hotel, Montreal, September 2-6, 1958, in a climate of international co-operation for the common good.

Seventeen countries were represented at the Montreal meeting, fifth in a series held over the past nine years, at Havana, New Orleans, Sao Paulo, and Mexico City. The last of these in 1956, had directed the activities of the past two years towards co-ordination of efforts throughout the Americas, technical standardization, and the promotion of a Pan-American study of the teaching of engineering. It was the hope that a proposal would be adopted at UPADI V to hold the first Pan-American Congress of Schools of Engineering at the next meeting in 1960, in Argentina.

Luis Giannattasio, Uruguay, president, and Walter S. Hill, secretary, presented a summary of the action taken since the Mexico meeting.

UPADI was founded for the promotion of scientific and technological progress of its associates and of mankind. Concerning itself with the intellectual and practical pursuits of the engineers of the Americas, it promotes and co-ordinates periodic Pan-American engineering congresses, conventions and exhibitions, and promotes personal contacts between the engineers of different countries. It encourages individual or group visits to member countries and to other places of interest, the interchange of professors, lecturers, engineers and engineering students, among the universities, schools and engineering associations, and closer technical relations among the American countries.

These delegates spoke on behalf of their countries and organizations at the opening session of UPADI. Left to right: F. Saturnino de Brito, Brazil; Luis Giannattasio, Uruguay, president of UPADI; Albert Deschamps, Canada, vice-president, E.I.C.; Sarto Fournier, mayor of Montreal; Dr. Irving Tait, Canada, chairman of the UPADI committee of E.I.C.; Enoch Needles, U.S.A., representative of the Engineers' Joint Council.

Dr. Luis Giannattasio, president of UPADI

Because of its own similar objectives the Engineering Institute now has friendly and co-operative relations with many societies and is a member of UPADI. The Institute council and members counted it a particular privilege to welcome the fifth convention to Canada. Vice-President Albert Deschamps made the first expression of welcome, on behalf of President K. F. Tupper. President Tupper participated in later sessions of the UPADI meeting.

The Honorable Sidney Smith, Secretary of State for External Affairs, in an address of welcome to the group said, "Engineering has been an essential factor in the growth of all American lands and it remains the symbol of their present achievement. "Not only," he said, speaking of UPADI, "Do you contribute to a high degree to better economic and technical relations between the countries of this hemisphere, but you establish as well a pattern of international co-operation which could be applied to many troubled areas around the world in order to strengthen the cause of peace."

At a civic reception given by the mayor and city council of Montreal, in the Hall of Honour at City Hall, Mayor Sarto Fournier, after extending the welcome of the City, made reference to the profession of engineering and its great contribution to the welfare of the peoples of the world.

The program included on September 2, the election and installation of three board members to replace outgoing members from Argentina, Brazil and the United States.

Resolutions committees were appointed on the subjects of administration, legislation, public relations, technical matters, budget, and teaching of engineering.

Administration Committee: A. Deschamps, Canada; W. Wisely, U.S.A.; M. T. Puente, Cuba; J. J. Gomensoro, Chile; H. de Almeida, Brazil; L. Balcazar Padilla, Mexico; M. A. Gonzilez, Venezuela. I. Vejo Rodriguez, Uruguay, spokesman.

Legislation Committee: F. Krug, Canada; G. Browne, U.S.A.; L. M. Alfonso, Cuba; R. Penades, Uruguay; B. Malta Marques, Brazil; M. A. Mantilla, Mexico; J. Taccani, Uruguay; S. De Brito Filho, of Brazil, spokesman.

Public Relations: Luis Giorgi of Uruguay, spokesman; Irving Tait, Canada; G. Hathaway, U.S.A.; R. Ondart, Argentina; J. L. Salcines, Cuba; H. Zaidan, Brazil; E. Ortega, Puerto Rico; H. Cassaigne, Mexico, and M. Villard, Haiti.

Technical Committee: C. C. Southmayd, Canada; A. Queirolo, Uruguay; R. T. Painter, U.S.A.; A. De Neymet, Mexico; R. Garcia Bango, Cuba; A. Van Langendonck, Brazil; E. Olivera Junior, Brazil, and J. Abella, Uruguay, P. Diaz Filippi, Uruguay, spokesman.

Budget Committee: spokesman, James Todd, U.S.A.; S. E. Reimel, U.S.A.; Q. Fernandez, Cuba; P. Leite Mascarenhas, Brazil; G. Padilla, Puerto Rico, and G. Sedes, of Mexico.

Engineering Education Committee: Ralph A. Morgen, U.S.A., chairman; H. G. Conn, Canada; H. Gaudefroy, Canada; L. Johnson, U.S.A.; I. Aviles, Mexico; J. Menendes, Cuba; R. Arrocha, Venezuela; M. Font, Puerto Rico; O. Castanhede, Brazil; L. Giannattasio, Uruguay; R. Ondart, Argentina; H. Tippenhauer, Haiti; and R. Penades, Uruguay.

Committee meetings continued from Tuesday, September 2, for three more days with the result that 46 resolutions were presented to the plenary session on Saturday by a co-ordinating committee.

At the formal opening on Wednesday there were talks by North, Central and South American and Carribean delegates. There was a report on the Conference of Engineering Societies of Western Europe and the United States (EUSEC), and one on the Federation of Commonwealth Societies.

The conference on engineering education continued on September 4.

The plenary session of the convention held September 6 was devoted almost wholly to the resolutions.

Joint participation in a number of functions was enjoyed by the ladies. Special events were also arranged for the ladies, including a scenic trip to the Laurentian mountains, north of Montreal, and a bus tour of points of interest in Montreal.

Resolutions of the Convention

Among the main resolutions proposed by the Co-ordination Committee to the 5th Convention of UPADI were proposals urging:—

- UPADI representation at the Organization of American States, in Washington, D.C.;
- regional centres for scientific investigation and specialized technology especially in Latin America;
- a program of scholarships, and the determining of special fields of engineering and applied sciences most necessary for each country;
- establishing of technical attaches in various embassies;
- preparation and distribution of technical publications;
- UPADI represenatives on various boards at proceedings involving adjudication of bids for great engineering works;

Above: Secretary of State for External Affairs, the Honorable Sidney Smith, extended Canada's welcome.

Below left: Ralph A. Morgan, of the Purdue Research Foundation, Purdue University, Layfayette, Indiana, and Hugh G. Conn, dean of the faculty of applied science, Queen's University, Kingston, Ont., who were among the four speakers in the conference on Engineering Education.

The other speakers, not shown, were Professor Octavio Cantahede, Brazil, and Rodolfo Felix Valdes, of Mexico.

Presentation of the flag of the Commonwealth of Puerto Rico to the E.I.C. by E. Ortega. Left to right: (first gentleman unidentified), A. Deschamps, Montreal, vice-president, E.I.C.; P. W. Gooch, chairman, Montreal Branch, E.I.C.; and Mr. Ortega.

• use of the decimal metric system in countries not now using it;
• a dictionary of technical terms in the four languages spoken in America;
• participation by member countries of UPADI in the International Association for the Exchange of Students for Technical Experience;
• maintenance of the Committee on Engineering Education so that it may continue the work it is doing and cooperate in the preparation of the first pan-American congress with the Board and the member in whose country the Congress will be held.

President Giannattasio's Talk

Speaking to all those gathered at the UPADI conference, Dr. Luis Giannattasio of Uruguay, president of the board of directors of UPADI said that the conference provided the means for studying, maintaining and perfecting professional abilities to serve the people of this hemisphere.

He referred to UPADI as an organization of enormous spiritual significance. Since 1949 four memorable meetings had taken place, and UPADI is making it possible he said, to establish close bonds between the various associations of engineers. A common Code of Professional Ethics for all engineers of America has been worked out, many aspirations formulated, coordination of conventions has been achieved, and techniques special to America have been considered by the Pan-American Committee of Technical Standards which began functioning in 1956, under the Brazilian Association of Technical Standards. UPADI's representation of the engineers viewpoints at meetings organized by the Organization of American States, will have important effects, he said.

Fundamental concern of UPADI, and the tone of its meetings, Mr. Giannattasio asserted, has been to point out the need to augment engineer training. Certain personal conditions must be cultivated by the engineer if he is to fulfill his transcendental functions in today's world. This is to be achieved, he said, through the various engineering faculties and associations.

Exploring another fundamental aspect of UPADI, Dr. Giannattasio urged that a greater number of young people be educated in science and technology. "In an age when the greater part of the work and responsibility of modern civilization, falls on the engineer and the investigator, training in the humanities must not be sacrificed," he said. "The principal problem of education is one of enabling men to organize and control the environment, to guide its evolution, to reduce sacrifice, to distribute the benefits of progress with justice.

Engineering Education Conference

Engineering Education in Canada

Discussing Engineering education in Canada, Dr. H. G. Conn pointed out that the strength of the engineering faculties in Canada lay in the fact that the schools are not identical. There are those schools which encourage a scientifically oriented curriculum and others which aim to produce a good solid practicing type of engineer, the "traditional engineer," a good balance of "know how, know why." But, according to Professor Conn, "most schools steer a wobbly path between these two."

He added, "the difference between the products of these two schools is frequently much more imaginary than real, the difference existing more in the minds and ambitions of the respective staffs than in fact." "There is, however," he added, "a general drift toward the scientifically oriented curriculum."

Most engineering schools plan to double available space by 1965, Dr. Conn reported. This brings out the need of having by that time a sufficient and a mature staff, whose "aging process must start now."

Dr. Conn cited the 5-year program as an answer to the present crowded curriculum of studies. Or another alternative is a fifth year, normally at an M.Sc. level, designed around research work or advanced study, for the best students.

Research in a university is necessary, "a whole field of thought above and beyond the details of day-to-day teaching." A gradual improvement in the salary differential between industry and university helps to attract and hold staff, from whose work constructive thought is stimulated.

"There is far too little real research being carried out at the universities," said Dr. Conn. This is being corrected gradually.

The large engineering schools are losing staff to the smaller schools, which until recently were "feeders" for the upper years of the larger schools. Several of these are now offering degree courses. Dr. Conn said, "Some question the wisdom of establishing new facilities at the present time, although few will argue against expanding existing facilities. It would be unfortunate if available teachers and money were spread unnecessarily thin in an attempt to meet a demand from industry for more engineers, unless of course, the demand is a real one. Although no one will question that there is and always will be a need for good quality creative engineers, there is some cause to doubt that there will continue to be a need for engineers to be employed on other than engineering work, work that could be done equally well by competent technicians, if they were available in much larger numbers than at present. While thinking along these lines it must be recognized that many employers prefer to engage engineers on work which is not strictly engineering, but which requires an engineering or analytical approach."

Dr. Conn concluded with a remark on the recommended practice for engineering students spending summer intervals working in an engineering atmosphere.

(continued on page 130)

A plaque commemorating the Montreal meeting of the Fifth UPADI Convention was presented to Dr. Tupper, president of the E.I.C., by Dr. Luis Giannattasio.

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

Confederation

Since the annual meeting of the Institute last May, considerable progress has been made towards Confederation.

At that time the plenary meeting of Council, on the recommendation of the Institute's Committee on Confederation, approved of certain clauses of a report submitted by the joint-sub-committee, as a "guide to further action." The meeting requested that the joint committee "continue its work" to the end that a report be prepared for the consideration and the balloting of the membership.

The Institute's committee has worked throughout the summer studying the problems and developing the suggestions contained in the report of the sub-committee. The result of this was the preparation of a long report which summarized the situation and extended the thinking farther into the future. This report was for the consideration of the Institute's officers and the members of the committee.

Subsequent to the study of the report by the Institute a meeting was arranged in Ottawa in August with the executive group of the Canadian Council committee. This was attended on behalf of the Institute by I. R. Tait, Montreal, chairman of the E.I.C. Committee, T. Foulkes, Ottawa, vice-chairman, and L. Austin Wright, Montreal, a member of the committee, and on behalf of the Canadian Council by John Fox, Toronto, chairman, Herb Smith, Toronto, and Guillaume Piette of Quebec.

This meeting lasted from nine in the morning until four thirty in the afternoon, and advanced the negotiations substantially. Several points already discussed were elaborated and classified, and many new angles of the proposals were developed and agreed upon. As well several points had to be left over for further study and discussion at a later meeting.

To summarize the action it can be reported that Dr. Tait has held three meetings of his group and has met twice with the Canadian Council group since the annual meeting. That is a lot of work and a lot of sacrifice of summer holiday time, by a group of voluntary workers.

Dr. Tait has enlarged his committee by the appointment of C. M. Anson, of Sydney, N.S., Leo Roy and Austin Wright of Montreal.

The closer one is to this matter the more clearly he sees the seriousness of it, the complications and the difficulties. Some members of the Institute have expressed concern at the length of time being taken, but to all those who have been working close to the problem it does not seem possible to move any faster. The situation is much more complicated than it would seem to one who has not studied it carefully. It is a serious matter of tremendous importance to the organizations concerned, and mistakes must not be made—not even to save time.

Sure progress is being made, piece by piece, and it is hoped that within a reasonable period of time a proposition that will really mean something will be available to the Councils of both organizations for their study and decision.

In the meantime, Dr. Tait proposes to report to each meeting of Council, and *The Engineering Journal* will present these reports to the entire membership, month by month.

IAESTE News

Duplication of requests has occurred in the matter of placement of mining students from the United Kingdom in summer vacation jobs in Canada through IAESTE. The Canadian Institute of Mining and Metallurgy and the Canadian Metal Mining Association, and IAESTE (Canada), will in future be able to avoid duplication of the requests for employment with which they have to deal.

After consideration by the professional institutions involved and by IAESTE in Great Britain, it has been agreed that all applications should be channelled through a single source. The source selected is IAESTE.

Any company wishing to receive students from a particular university or college would do so by advising IAESTE (Canada), accordingly. Offers may also be reserved for students to be nominated by professors abroad having specific contacts in Canada.

Addresses to be used are: In Canada—IAESTE Committee, c/o The Engineering Institute of Canada, 2050 Mansfield Street, Montreal; in the United Kingdom—The Executive Secretary of IAESTE (GB), 178 Queens' Gate, South Kensington, London, S.W. 7.

Canadian mining and metal industries are invited to advise the Canadian IAESTE committee in the autumn, of the numbers of mining, metallurgy and any other students they are prepared to receive from the United Kingdom the following summer. This information, once relayed to the committee in Great Britain, will facilitate selection of students from the universities. When necessary, the committee will also act in collaboration with the Institution of Mining and Metallurgy in London. Canadian industries receiving direct applications from individuals in Great Britain need only pass these on to the Canadian IAESTE secretary without comment.

DID YOU KNOW THAT

350 employers used the Employment Service of the E.I.C. in 1957 to obtain engineering personnel. Fifteen hundred engineers visited the department.

The Pines, Digby, N.S.

The Conference Committee: front row, Mrs. Myra Lusby, ladies committee, G. H. Dunphy, general chairman, H. W. Doane, Jr., secretary; back row, W. J. Phillips, L. F. Kirkpatrick, vice-chairman, F. C. O'Neill, entertainment and sports, W. T. Windeler, registration, G. F. Vail, papers and speakers, H. A. Marshall, publicity. G. N. Haliburton, finance, was absent when the picture was taken.

Maritime Professional Engineers Conference

Branch chairman were out in full force. In this group, front, C. Trenholm, Moncton, President K. F. Tupper, General Secretary Garnet T. Page, and J. Wilson, Sackville; back row, C. W. Henry, St. John's, H. M. W. Townsend, Saint John, J. A. McLaren, E.I.C., Toronto, J. F. Clarke, North Nova Scotia, C. W. Currie, P.E.I., J. D. Kline, Halifax.

The ladies shown enjoying the morning sun are Mrs. J. F. Callahan, Mrs. F. G. Murphy, Mrs. F. C. O'Neill, Mrs. J. B. Dicks, Mrs. G. E. Franklyn, Mrs. J. A. G. Brown and Mrs. J. A. Marshall.

ENGINEERS in record numbers registered at Digby, N.S., for the Maritime Professional Engineers' Conference, held at The Pines, September 2, 3, 4, 5, 1958.

This response to the efforts of the organizing committee prompted the conference chairman Gordon H. Dunphy to comment that it is apparent that recognition of the calibre of the Maritime Convention is spreading, resulting in many delegates from outside the Atlantic Provinces taking an interest. The engineers' wives obviously favour this meeting, for there were many there with their husbands.

The maritime meetings, held every second year, have been pleasant and profitable in the past as they alternate between St. Andrew's, N.B., and Digby. This year's meeting was hugely successful, with representation from as far afield as Toronto and Hamilton. Gordon Dunphy's request that the delegates enjoy themselves to the utmost met no opposition.

The fine attendance, beautiful weather, excellent technical papers, and exceptional entertainment were the main elements of success.

The *Eager Beaver*, official journal of the meeting suggested other particular elements, such as the Early Bird Breakfast, the Maripenco Club, golf tournament, dancing, etc.

The Maritime hosts were, of course, the Associations of Professional Engineers of Newfoundland, Prince Edward Island, New Brunswick, and Nova Scotia, and the eleven Maritime Branches of the Engineering Institute.

They welcomed representatives of the Association of Professional Engineers of Ontario, C. T. Carson and J. H. Fox, president and past-president; of the Corporation of Professional Engineers of Quebec, Guillaume Piette, President, and Pierre

At the first luncheon, J. D. Kline, Halifax branch chairman, presented souvenir trays to Dr. K. F. Tupper and Mr. D. O. Turnbull of the Canadian Council. Both were speakers at this luncheon.

Bournival, general secretary; of the Canadian Council of Professional Engineers, D. O. Turnbull, vice-president and L. M. Nadeau, secretary-treasurer.

President K. F. Tupper of the E.I.C. was present with General-Secretary Garnet T. Page. They expressed the Institute's great interest in such co-operative regional meetings, of which the Maritime Conference has a very long record of achievement. Other Institute staff members were on hand to help, including John A. McLaren, the eastern field secretary.

The technical part of the program, consisted of papers as follows:
"Canada's Progress Toward Economic Nuclear Power", by J. L. Olsen.
"The Shippegan Island and Campebellton Bridges".
"Engineering Management of an Advanced Weapon System", by C. V. Lindow.
"Industrial Application of Computers", by Admiral G. L. Shephens.

Presiding at and taking active parts in professional sessions and luncheon and dinner meetings were officers of the Maritime Associations and the E.I.C. Branches. The first luncheon featured greetings by a representative of His Worship G. R. Turnbull, Mayor of Digby, by D. O. Turnbull of the Canadian Council, and Dr. Kenneth F. Tupper.

The dinner speaker on Wednesday was Hon. R. A. Donahoe, Q.C., Attorney General of Nova Scotia. J. S. Richardson, of Montreal gave a luncheon address on the refreshing subject of "Old Inns of England". Speaker at the banquet on Thursday evening, September 4, was Dr. Will R. Bird of Halifax.

The proceedings were the best possible argument in favour of the next conference, scheduled for 1960 at St. Andrew's, N.B.

Everyone made the Early Bird's Breakfast but a few just barely. Below, General Secretary Garnet Page and 299 others made the Early Bird's Breakfast.

Above, a group of M.P.E.C. enthusiasts: Dr. K. F. Tupper, Dr. J. Hoogstraten, of N.S.T.C., Dr. J. B. Stirling and Dr. I. P. McNab, past presidents.

Some conference committee members in action; H. C. Rounsefell, F. C. O'Neill, L. F. Kirkpatrick, G. H. Dunphy, Mrs. Dunphy and Mrs. T. Lusby.

Nominees for Office

Engineering Institute of Canada

The report of the Nominating Committee, as accepted by Council at the meeting held on September 2nd, 1958, is published for the information of all corporate members as required by Sections 19 and 40 of the by-laws:

Vice-Presidents	
*Zone A (Western Provinces)	C. V. Antenbring, Winnipeg, Man.
*Zone B (Province of Ontario)	R. B. Chandler, Port Arthur, Ont.
*Zone C (Province of Quebec)	F. L. Lawton, Montreal, Que.
Councillors	
†Yukon	N. Gritzuk
†Vancouver Island	P. F. Fairfull
†Vancouver	P. N. Bland
†Central British Columbia	H. R. Hatfield
†Kootenay	A. F. Brooks
†Edmonton	S. J. Hampton
†Saskatchewan	A. H. Douglas
†Winnipeg	Stewart Barkwell
†Lakehead	D. B. McKillop
†Sudbury	F. A. Orange
†London	A. L. Furanna
†Port Hope	Harry Gadd
†Kingston	J. W. Dolphin
†Nipissing & Upper Ottawa	J. W. Millar
†Border Cities	W. G. Mitchell P. N. Brown
‡Toronto	Harvey Self
†Belleville	A. D. Janitsch
†Brockville	J. S. Waddington
†Chalk River	C. A. Crawford
‡Ottawa	Hector Chaput
§Montreal	T. N. Davidson P. W. Gooch Jacques Hurtubise
†Eastern Townships	A. S. Mitchell
†St. Maurice Valley	Viggo Jepsen
†North Shore Lower St. Lawrence	W. S. Martin
†Lower St. Lawrence	L. P. Dancose
†Saguenay	A. B. Sinclair
†Baie Comeau	Charles Miller
†Fredericton	S. B. Cassidy
†Saint John	T. C. Higginson
†Halifax	R. D. T. Wickwire
†Amherst	Lawrence L. Spurr
†Prince Edward Island	N. F. Stewart
†Corner Brook	M. C. Collins
†Newfoundland	C. H. Conroy

*One Vice-President to be elected for two years
†One councillor to be elected for two years
‡One Councillor to be elected for three years
§Three councillors to be elected for three years each

Aid for Education

A plan to provide financial assistance for full-time employees taking voluntary out-of-hours educational courses — including engineering — has been put into effect by The Bell Telephone Company of Canada.

Full-time employees—both men and women—may apply for reimbursement for courses likely to broaden their usefulness to the company, either in their present positions, or in positions that they might reasonably be expected to qualify for in the future.

Reimbursement for half the tuition cost to a maximum $150 annually, may be claimed by employees taking acceptable courses, whether the language of instruction is English or French.

The company's educational assistance plan is available to employees taking evening courses at colleges and universities, and to those attending certain evening classes at secondary or high schools. Employees without access to suitable classes, but who receive instruction by correspondence from universities or recognized correspondence schools, may also apply for assistance.

Providing they do not duplicate the courses available in the Bell company's plant schools, courses for craftsmen could include electricity, electronics, engineering or business administration. Clerks or telephone operators might be interested in shorthand and typing, or university courses in arts, science or commerce.

The plan is administered by regional interdepartmental committees, which are responsible for interpreting company policy. The advice of supervisors is taken into consideration in each case, since they are in a position to know whether the required time will interfere with the job, whether the employee is likely to complete the course and in what way he or she may benefit.

If closely related to the job, tuition in individual subjects below junior matriculation may be acceptable. However, basic education is a personal responsibility of the individual employee.

The Bell company's offer of financial assistance toward the cost of voluntary out-of-hours educational courses is based on the fact that technical proficiency and specialized knowledge are becoming increasingly important to its employees because of the growing complexity of company operations. As a result, the plan will prove especially helpful to engineers following technical or management courses.

It is estimated that some 1,600 employees have been taking voluntary out-of-hours educational courses of various types over the past year. More than half of these employees will be covered by the new plan during the coming term.

ENGINEERING JOURNAL

July Issue, 1958

The July issue of *The Engineering Journal* is in very short supply.

We would be very grateful if any members not wishing to retain their copies would send them to The Librarian at Headquarters.

UN Conference on Atomic Energy

Canada's delegation to the Second United Nations International Conference on the Peaceful Uses of Atomic Energy, Geneva, Switzerland, September 1-13, 1958, was headed by Dr. W. B. Lewis, vice-president, research and development, Atomic Energy of Canada Limited. His associates were Dr. A. R. Gordon, of A.E.C.L. and University of Toronto; R. E. Barrett, of Eldorado Mining and Refining Limited; Dr. H. G. Thode, of National Research Council and McMaster University; and M. H. Wershof, Canadian delegate to U.N., Geneva. The delegation included 65 advisers from private industry, universities, government departments and Atomic Energy of Canada Limited.

Canadians submitted 47 scientific papers to the meeting of some 5,000 scientists from 80 countries. The Canadian papers covered such topics as the atomic energy program, the NRU Reactor, types of ores in the various uranium mining regions, uses of radioactive isotopes, cancer therapy, health and safetv in the operation of atomic installations and disposal of fission products.

Canada's exhibit at the conference covered the full range of atomic energy developments in this country from the uranium industry through fundamental and applied research to radioactive isotopes. There is a model of the NPD (Nuclear Power Demonstration) our first atomic power station, with fifteen models of atomic power reactors, cancer treatment machines, a uranium mine mill and the research reactors at Chalk River.

The most important result of the first Conference, held in 1955, was the very open exchange of information, said the conference secretary-general, Sigvard Ekland, in *United Nations Review*, July 1958. English, French, Spanish and Russian versions of the proceedings were published, which are now generally considered to be an encyclopedia in this field.

This year's second conference was held at the request of the Secretary-General of UN, on the recommendation of his Advisory Committee on Atomic Energy. The member states and the specialized agencies of UN were invited to participate, with the result that during March, April and May, this year, 2,409 abstracts of papers were received by the conference secretariat. The twenty-one scientific secretaries assisting in the scrutiny of abstracts included Canadians Thomas Church, of Atomic Energy of Canada Limited, Chalk River, and Dr. Harold Copp, Prof. of Physiology of University of British Columbia.

The program contained this year the general sessions and five parallel series of sessions. The general sessions covered such topics as the future of nuclear power, experience with nuclear power plants, the possibility of controlled fusion, progress in the use of isotopes, recent developments in fundamental physics and international collaboration in the field of atomic energy. The five technical series of sessions dealt with (1) physics, (2) reactors, (3) chemistry, (4) isotopes and radiological protection, and (5) raw materials and metallurgy. The total number of sessions were 77 as compared with 55 in 1955.

The proceedings of the second Conference will be published in English, during the early part of 1959, with abbreviated versions in Russian, Spanish and French. The proceedings are estimated to consist of 33 volumes.

Annual Meeting 1959

ENGINEERING INSTITUTE OF CANADA

Toronto

Royal York Hotel

June 8, 9, 10

Members are invited to submit papers for the meeting to the Committee on Technical Operations. Full information appeared on Page 113 of the September issue of the *Journal.*

Authors were asked to observe these deadlines: November 1, 1958, receipt of title of paper and name of author; December 1, receipt of abstract; February 1, 1959; receipt of manuscript.

Four of Canada's five official representatives to the Second United Nations International Conference on the Peaceful Uses of Atomic Energy, 1958. Left to right are: R. E. Barrett, Ottawa, Dr. A. R. Gordon, Toronto, Dr. W. B. Lewis, Chalk River, leader of the delegation, and Dr. H. G. Thode, Hamilton, Ont. The other representative is M. H. Wershof, member of Board of Governors, International Atomic Energy Agency, Vienna, and Canadian Representative to UN, Geneva.

Student delegates to the annual meeting of the Institute last May at Quebec City were: Donald J. Thomson and W. M. Calderwood of U.B.C.; R. W. Pollock, Alberta; W. A. Neff and T. W. B. MacFarlane, Saskatchewan; Ken A. Bailey and B. K. Laxdal, Manitoba; W. J. Simpson and R. B. Schaeff, Toronto; David R. Durnford, Western Ontario; Andrew M. McMahon and John E. Vollmer, Queen's; P. V. Glasheen, R.M.C.; Philippe Lemay, Ottawa; Andre Rinfret, Ecole Polytechnique; George M. Desjardins, McGill; Gilles G. Henault, Sherbrooke; Michel Chamberland and Gaston Asselin, Laval; Hans Foerstel, New Brunswick; and John Jay, N.S.T.C. Photographed with the students were: Henry P. Gatin of E.I.C. Headquarters, C. G. Southmayd, Montreal, chairman of the Conference, and Miss Gillian Clover of Headquarters.

Hoosac Tunnel

Robert F. Legget, M.E.I.C., supplied this picture of the Hoosac Tunnel, the construction of which is recorded in "Daylight Through the Mountain", published last year by the E.I.C.

The tunnel, he reports, is in very good shape but one of the two tracks has been removed due to decrease in traffic and the necessity of obtaining extra headroom for the single remaining track in order to accommodate the "piggy back" traffic which the Boston and Maine Railroad are now developing.

The strange cover over the portal is a metal casing in which slides a metal door which is dropped to close off the tunnel during the winter when the weather is extremely cold.

Elections and Transfers

A number of applications were presented for consideration and on the recommendation of the Admissions Committee, the following elections and transfers were effected at a meeting of Council held on September 2.

Members: D. Biggar, Kingston; H. R. Bryett, Vancouver; H. S. Chapman. Calgary; D. Gunasekera, Ceylon; L. G. Harmsworth, Toronto; A. P. Humble, Ottawa; N. H. Kearns, Copper Cliff; P. J. Killaby, Toronto; D. S. McIntosh, Calgary; C. E. Michener, Toronto; R. C. Monaghan, Hamilton; H. J. Mutz, Copper Cliff; S. Persson, Toronto; C. Pozsonyi, Montreal; O. B. Schier, New York; D. A. N. Scott, South Africa; H. Skantze, Arvida: R. W. Smith, Toronto; K. B. Snaggs, Trindad, B.W.I.; C. J. Stewart, Toronto; S. G. Wickham, Montreal; A. H. Wilson, Chalk River.

Juniors: M. M. Abbas, Ottawa; J. R. Ariss, London; R. C. Freeman, London; J. Huva, Quebec; D. R. Parkes, Victoria; D. R. Peach, Shawinigan; G. J. Trausch, Quebec; G. T. Trotter, Toronto; D. R. Van Sickle, Houston, Texas.

Affiliate: W. H. Taylor, Calgary.

Junior to Member: A. G. Fletcher, Vancouver; M. R. Kent, Ottawa; J. Klimovich, Vancouver; R. E. Manning, Toronto; J. C. Stevens, Victoria; E. H. Talbot, Vancouver.

Student to Junior: J. R. Dean, Fredericton; W. R. Sexsmith, Shawinigan.

STUDENTS ADMITTED

McGill University: C. Giannakakis. J. K. Nixon. **University of Alberta:** P. J. Kostiw. **University of Toronto:** R. D. Thibodeau. **University of B.C.:** L. H. Nohr. **University of London:** N. R. Spencer. **University of Toronto:** M. G. Masuda, B.A.Sc. (elec.), 1958. **University of Sask.:** S. J. Yaki, B.E. (mech.), 1958. **Queen's Univ.:** V. Olsevskis, B.Sc. (chem.) 1958. **McGill University:** C. Cote, B.E. (civil), 1958.

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members: R. K. Ulveland, G. L. Ward; **Junior:** G. R Ursenbach; **Student to Junior:** N. M. Boyd.

SASKATCHEWAN

Members: J. D. S. Brookes. J. W. Harding, R. J. Fleming, D. B. Phillips, J. D. Fowler. **Junior:** R. A. Fox. **Junior to Member:** J. M. Crawford, E. G. E. Wurts. **Student to Junior:** A. A. Gorkoff.

NOVA SCOTIA

Junior to Member: J. H. Boyce, R. L. McCarther, M. R. Leybourne, J. P. Livingston.

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Frank P. Vaughan, M.E.I.C., of Saint John, N.B., retired consulting electrical engineer and contractor of radio pioneering fame, died at his home in Saint John on August 8, 1958.

Born at Liverpool, England, on June 3, 1874, Mr. Vaughan attended Regent College, Southport, England. Later he acquired engineering skills at the Massachusetts Institute of Technology.

On the threshold on his career in 1891, at Vancouver, he worked with a telephone corporation, through which he was connected with several British Columbian interests. Four years later, established in Eastern Canada he worked with Canadian and American companies at Yarmouth, N.S., Saint John, N.B., Boston and Schenectady, N.Y. He settled at Saint John in 1902 and opened a private practice as electrical engineer and contractor. The Vaughan Electric Company Limited came into being in 1906.

In 1904 he was granted a licence for experimental wireless telegraphy, and was in four years able to project his voice a distance of three miles by wireless telephone, thus contributing to his renown in wireless telegraphy, telephony and high potential high frequency currents. These creative stages of wireless communications arrested widespread attention among scientific writers. The first radio broadcasting station in New Brunswick was designed, built and put into operation by him in 1923. This was station 9-B1.

For long and faithful service to his profession, the University of New Brunswick in 1922 conferred on him an honorary M.Sc. degree.

Mr. Vaughan held office in the Institute as branch chairman at Saint John in 1921. Four years later he was councillor representing that branch.

Mr. Vaughan became a member of the E.I.C. in 1919 as an Associate Member, became a Member in 1920 and attained Life Membership in 1942.

Late in life, after retirement, he devoted a great portion of his time to art. He developed an unusual skill in the use of colored pencils, producing effects that were difficult to distinguish from oil painting. His favorite subjects were animals and birds. All his pictures were remarkable for their life-like portrayal and for the third dimension that appeared in them all.

He did some work in oils and water colours as well, but his colored pencil "paintings" were his greatest achievement. The Institute is fortunate in having several of his finest works on the walls at Headquarters.

It is men like Mr. Vaughan who give life and purpose to a learned society. He participated in all activities at the branch, provincial and national levels. He presented papers, he held office, he worked for the Institute, and for other organizations as well in which he found interest.

Many circles, including engineering, have been greatly enriched by the support and loyalty of this great man. A true gentleman, he attained distinction but without vainglory in his greatest field of interest—engineering. The profession could do with more like him.

Dr. P. L. Pratley, M.E.I.C., consulting engineer of Montreal, died in that city on August 1, 1958.

Philip Louis Pratley was born at Liverpool, England, on December 4, 1884, and studied at the University of Liverpool, gaining a B.Sc. degree, in 1904, a B.Eng., degree in 1905, M.Eng., 1908, and an D.Eng., in 1939.

He moved to Canada in 1905 and worked with the Quebec Bridge Board of Engineers, Department of Railways and Canals. Later he gave extensive service to the St. Lawrence Bridge Company of Montreal, the Dominion Bridge Company Limited, the Grand Trunk Railway System and its subsidiaries. Dr. Pratley was associated with the Dominion government, various provincial governments, cities and municipalities throughout the country, by railways and industrial corporations, by private companies and general contractors. He also collaborated as Canadian consultant with different American engineering firms on international bridges.

At the time of his death he was consulting engineer for the new Champlain bridge at Nun's Island, Montreal.

Lately he was called in on the collapse of the Second Narrows Bridge, Vancouver.

Dr. Pratley gave many years service to the E.I.C. He was a member of the council representing the Montreal Branch from 1927 to 1934, was elected E.I.C. treasurer in 1933, and became a vice-president in 1935 and 1936.

In addition to his service on the Council Dr. Pratley was Canadian member of Council for the Institution of Civil Engineers of London.

Twice a winner of Institute awards, these were the Gzowski Medal, in 1935, and the Duggan Medal. He was its first recipient in 1937.

Dr. Pratley joined the Institute as a Student in 1907, transferred to Associate Member in 1909, and to Member in 1917. He became a Life Member in 1946, Honorary Member in 1958.

Seldom has the profession of engineering in Canada suffered the loss that it experienced recently with the death of Dr. Pratley.

Dr. Pratley's mark on the engineering profession in Canada is deep and impressive for two things. Firstly, his outstanding technical ability and secondly, his equally outstanding character. Few engineers have ever enjoyed the high reputation that came to Dr. Pratley because of this combination of sterling qualities.

He was a man who was interested not only in his work but in the welfare of his profession as well. He devouted many years of interest to the affairs of the Engineering Institute in serving the society in many capacities and contributing many papers to the meetings and to the Engineering Journal.

It is a great thing for a profession that it can find within its ranks outstanding gentlemen of great competence who are indeed "a decoration to the house". The profession has been greatly enriched by Dr. Pratley's achievements in all the fields in which he has shown an interest.

P. C. Kirkpatrick, M.E.I.C., of Montreal who died on June 30, 1958. An obituary item appeared in the September issue of the *Journal.*

James Forgie, M.E.I.C., consulting engineer, pioneer and expert on subaqueous tunnel design and construction practise, died on August 13, 1958, in New York City, at the age of 90.

Mr. Forgie was born in Scotland. After graduating from Gordon's College, Aberdeen he began his professional engineering career in London. He was associated

(Continued on page 108)

P. C. Kirkpatrick, M.E.I.C.

Dr. P. L. Pratley, M.E.I.C.

W. S. Wilson, M.E.I.C.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

BRITISH COLUMBIA

THE SIXTEENTH ANNUAL CONVENTION of the Municipal Engineers' Division of the Association of Professional Engineers of B.C., which concluded its three day session in Prince George on September 20 attracted 260 d legates and their wives. Final day was devoted to field trips of engineering interest in the community, including the water treatment plant, the new earth resevoir and waterworks pump house, and the municipal land assembly project which will provide 177 large lots, completely serviced with underground lighting and telephone connections, sewers and all facilities at a purchase price of $1800 per lot.

Bold New Look

A highlight of the business session was a paper on "Labour Relations and the Municipal Engineer" by G. A. Wilkinson, (of Vancouver), vice-president, Marwell Construction Company and noted provincial labour relations authority. A former member of the Vancouver Trades and Labour Council, he has also served on the Labour Relations Board of the province.

Mr. Wilkinson called for a "bold new look" to establish industrial peace, and expressed the opinion that strikes have long since outlived their usefulness as an instrument for attaining union objectives. He advocated rescinding or amending the obsolete Trade Union Act of 1907 and bringing labour relations procedures up-to-date in order to fit the changed conditions which have brought organized labour to a position of power and responsibility in the economic welfare of society. He warned against placing full blame for labour troubles entirely on the unions, at the same time as he described the results of irresponsible tactics of some sections of organized labour.

He stated that "our Number One problem is communication, coupled with education" to insure that all sections of the public, including labour, are aware of what these labour disputes are costing us, and that they are no longer arguments between employers and employees, but are everybody's business. He cited a recent case where the votes of 16 individuals in Vancouver gave a union the right to tie up every construction job throughout the province. "How silly can we get?" he asked.

Reviews Wenner-Gren Project

At the annual banquet the Hon. Ray Williston, Minister of Lands and Forests, reported on progress to date of the vast Wenner-Gren project in the Rocky Mountain Trench of northern B.C. Engineering data obtained at a cost of $8 to $10 million is being turned over to the government, and will be of immense value "whether or not" the main project of the mono-rail railway is carried out to completion, the Minister said. Among the several subsidiary developments under consideration is a four million horsepower hydro-electric development north of Prince George. This enormous new power potential, the Minister said, has already put Canada in a much stronger bargaining position with the United States in the development of Columbia River power.

Elected to the executive of the Municipal Engineers' Division of the Association of Professional Engineers of B.C., at their annual meeting in Prince George, September 18 to 20, were, left to right, (standing), S. Lefeaux, P.Eng., J. A. Merchant, P.Eng., registrar of the A.P.E.B.C.; A. S. G. Musgrave, P.Eng., and G. O. White, P.Eng. Seated are Ron Cameron, P.Eng., G. Q. Lake, P.Eng., G. Meckling, P.Eng., and G. P. Harford, P.Eng.

North West Highway System Paper

Another interesting paper on the "Northwest Highway System" was presented jointly by Lt. Col. D. M. C. Saunders, M.E.I.C., of the Royal Canadian Engineers, and Mr. B. A. Yates, M.E.I.C., both of Whitehorse. They reported in detail on the Canadian Army's stewardship of the 1221 miles of the Alaska Highway from Dawson Creek to the Alaska border. Along this vast and isolated stretch the Canadian Army is responsible not only for road maintenance and repair, but for the public utilities, the sewerage and waterworks and power facilities along the route. Some idea of the difficulties and variations existing in different localities is the cost of supplying water, which ranges from $3.58 per thousand cubic feet at Muskwa on Mile 259 to 15c per thousand at Whitehorse. The paper went into specific detail about techniques developed under special conditions of climate and terrain for highway maintenance and public utilities. For this reason it was perhaps the most interesting and novel of all the business sessions at the convention.

Lagooning Method of Sewage Disposal

The "Lagooning" method of sewage disposal, which is both inexpensive and effective for smaller communities, was outlined by R. Bowering, P.Eng., director of public health engineering of the Department of Health and Welfare, Victoria. Seven B.C. communities are already using this method with good results, Mr. Bowering stated. According to climactic conditions the sewage is effectively disposed of with a three to five foot depth of shallow pond which provides one acre of area to approximately 200 population on the system. When properly constructed, or where suitable natural ponds exist, the necessary depth is maintained entirely by the influx of waste, and very little attention is required. Because of the absence of odour they may be located as close as 500 feet away from public travel and there is no unsightly matter on the surface, although Mr. Bowering recommended that they should be screened from public view.

Contracts Discussed

A. J. MacDonald, P.Eng., gas distribution manager of the B.C. Electric Company, Abbotsford, outlined the advantages of forms of contracts developed with great economy and satisfaction for projects involving the installation of natural gas mains. After progressive experience with various forms of low-bid and negotiated contracts, he advocates a unit-cost plus fixed fee arrangement which could be adapted, with modifications, to municipal engineering requirements. By working toward an elimination of risk plus an established profit for the contractor, Mr. Macdonald found that costs declined steadily and sharply as contractors became familiar with the work to be done. Comparative savings, within the course of one year, amounted to nearly 50 per cent in some instances. He concluded that the most advantageous form of contract, which could be adapted to apply to certain forms of maintenance as well as new construction, is a continuing contract with an incentive factor that reimburses the contractor for all his expenses and adds a fixed fee per unit of work to cover overhead and profit.

Asks Careful Work Scheduling

George Wallach, of the regional National Unemployment Commission in Vancouver, told delegates that very serious employment problems are anticipated this winter. He made a plea for municipal authorities throughout the province to schedule works and purchases so as to provide as much additional work as possible during the normally slack season.

He reported that Vancouver had already decided to provide $4,000,000 for special projects this winter, and announced a national "Plan Now" campaign, starting in November, to stimulate both private and public employers to spread work over the winter months. Among his concrete suggestions were the elimination of overtime and "moonlighting" (the holding of two jobs by one man), winter schedules of public works, and acceleration of purchasing programmes to stimulate employment in the supplying industries.

Talk on Soil Conditions

M. C. Nesbitt, P.Eng., regional construction engineer for the Department of Highways at Prince George, spoke on soil conditions and treatment in connection with the new stretch of paved highway between Prince George and Quesnel.

Charles Broadbridge of Vancouver, showed coloured slides of the new Deas Island tunnel in Vancouver, and C. E. Leonoff, P.Eng., told about the "Construction of an Earth Water Storage Reservoir for the City of Prince George" for which his firm, Ripley and Associates, had been the consulting engineers.

Executive Elected

New executive of the Municipal Engineers' Division for 1958-59 are: G. Q. Lake, P.Eng., Burnaby; Stuart Lefeaux, P.Eng., Vancouver Parks Board; George Meckling, P.Eng., North Vancouver District; Ronald Cameron, P.Eng., Richmond; G. O. White, P.Eng., Oak Bay, Vancouver Island; and G. P. Harford, P.Eng., who has resigned as city engineer of Prince George to take up his post in the planning division of the Vancouver City engineering department. Honorary secretary is A. S. G. Musgrave, P.Eng., founder of the Municipal Engineers' Division and former municipal engineer of Oak Bay. Secretary-Treasurer is J. A. Merchant, P.Eng., Registrar of the Association of Professional Engineers of B.C.

ONTARIO

Engineers in the News

George W. Vosper, P.ENG., who is on the teaching staff of the department of mechanical engineering, Royal Military College, Kingston, Ont., has recently been elected a director of the Eastern Ontario Development Association. Last year Mr. Vosper was on the executive of Zone 2 of this body and he is presently serving, also, his second year both as alderman of the City of Kingston and a director of the Kingston Chamber of Commerce. As a matter of interest, both aldermen representing Mr. Vosper's ward are professional engineers — his fellow-alderman being Col. L. F. Grant, P.ENG.,

Robert Wilson Higgs, P.ENG., recently completed post-graduate studies at Cornell University and received the degree of Master of Science in Transportation on an International Road Educational Foundation fellowship awarded through the Canadian Good Roads Association. He is returning to Ottawa to resume employment with the highways division, Department of Public Works of Canada.

Malcolm M. Turnbull, P.ENG., has been appointed city engineer and commissioner of works of the City of Belleville, Ont.

Before accepting the appointment in Belleville he was engineer of streets and sanitation in Ottawa.

Professional Engineers Wives Association

The winter and spring activities of the Professional Engineers' Wives Association concluded with a buffet at the Savarin, Toronto. This Association originated with the wives of the graduating classes of 1950 and 1951 of the University of Toronto and later graduating classes have since joined. Last year the membership was extended to wives of all graduate engineers from any accredited university.

The group has given enthusiastic support to the raising of funds to provide a bursary to an engineering student. In addition to a $500 bursary, funds were raised to make a loan available to fourth year students.

Mrs. H. R. Fielding succeeds Mrs. L. W. Alexander as president and the executive includes: Mrs. B. G. De Graaf, vice-president; Mrs. R. P. Sloan, secretary; Mrs. E. J. Bartley, treasurer; Mrs. L. W. Alexander, auditor; Mrs. G. R. Truewin; Mrs. J. M. Clarke; Mrs. K. H. Sharpe; Mrs. M. A. Couse; Mrs. W. D. Bonisteel; Mrs. H. V. Ivers; and Mrs. R. H. Andrews.

George R. Mills, P.ENG., of Ethyl Corporation of Canada Ltd., has been promoted to the position of operations superintendent at its Sarnia, Ont., plant. A 1957 graduate in engineering from the University of British Columbia, Mr. Mills joined Ethyl of Canada in 1955 after varied experience in the chemical and petro-chemical field.

Barry E. Smith, P.ENG., has accepted a position with the Corporation of the City of Oshawa, Ont. He was formerly with the consulting firm of Marshall, Macklin Monaghan Ltd., Don Mills, Ont.

R. J. Thomas, P.ENG., has left for Sarawak where he has accepted a position with the public works department of Sarawak as an executive engineer. He will be located at Kuching, Sarawak.

V. B. Schneider, P.ENG., has moved from Lively to Ottawa, Ont., where he has joined the mineral resources division of the Department of Lands and Technical Surveys of Canada. Prior to this change, Mr. Schneider was associated with the International Nickel Company of Canada Ltd., at Copper Cliff.

A. J. G. Leighton, P.ENG., is leaving the Hydro-Electric Power Commission of Ontario, where he has held the position of manager of the Whitedog and Caribou Falls construction projects, to accept the position of program control engineer with the British Columbia Power Commission, Victoria, B.C.

Harold Evans, P.ENG., has left the Canadian General Electric Co. Ltd., Peterborough, Ont., and has moved to Montreal, Que., where he is employed by the Montreal Engineering Company.

Thomas Thompson, P.ENG., has left Toronto and is now located in Rugby, England, where he is presently with the English Electric Co. Ltd.

Walter N. Button, P.ENG., who has been project approvals engineer with the Frequency Standardization Program of Ontario Hydro, has been transferred from St. Carthanines to Cornwall, Ont., where he is with the H.E.P.C. operations divisions at the Robert H. Saunders Generating Station.

W. J. Notley, P.ENG., of the engineering department of Canadian National Railways, has been transferred from Montreal to the Toronto offices.

Donald L. Melick, P.ENG., of the Bell Telephone Company of Canada, is Toronto area plant personnel supervisor and is located at 393 University Ave., Toronto.

Management Training Course

Of 122 enrolled in the August 1958 Management Training Course of the University of Western Ontario School of Business Administration, at least 18 are professional engineers with companies or utilities in Ontario or Quebec. Of these, over half are Ontario professional engineers and include D. M. Alloway, P.Eng., Oshawa; J. S. Crerar, P.Eng., Alex De Maio, P.Eng., E. R. Gill, P.Eng., and Gordon Macivor, P.Eng., of Toronto; H. R. D. Graham, P.Eng., North Bay; B. R. Lewis, P.Eng., Hamilton; T. N. McLenaghen, P.Eng., Iroquois Falls; V. M. Norwood, P.Eng., Corunna; and J. W. Thomson, P.Eng., Timmins.

Alexander Watson P.ENG., of the Department of Transport of Canada, has been promoted director of ship construction and supply. Mr. Watson has been with the Department for over 20 years and prior to his recent promotion was associate director of marine services.

Fred R. Dorward, P.ENG., has joined Angus Butler & Associates Ltd., Edmonton, Alta., as head of the electrical department of this firm of consulting engineers. He was formerly with Crowther MacKay & Associates Ltd.

M. R. Laundry, P.ENG., is now with Orenda Engines Ltd., Malton, Ontario, as a mechanical engineer. He was formerly employed with L. H. Schwindt & Co. Ltd., at Burlington, Ont.

D. R. McAuley, P.ENG., of Ottawa, Ontario is a defence production officer in the electronics branch of the Department of Defence Production.

Col. R. H. Ramsay, P.ENG., has been appointeed Commandant of the RCEME School at Kingston, Ont. His appointment and promotion to the rank of colonel took effect on August 18, 1958.

Col. Ramsay, who graduated from McGill in 1940, has been deputy director (production) in the Directorate of Electrical and Mechanical Engineer for the past year.

OBITUARIES *(Continued from page 105)*

with the outstanding United Kingdom firms of Sir Benjamin Baker and Company, and Sir Basil Mott and Hay. Mr. Forgie took part in building tunnels for the London Underground before the turn of the century. In 1902 the Pennsylvania Railroad invited Mr. Forgie to New York to provide advice on the design and construction of tunnels under the East and Hudson rivers. Completed in 1910 these tunnels became the models for subsequent shield-driven tunnels in the U.S.A.

Shortly after this Mr. Forgie became a partner in the consulting firm of Jacobs and Davies, which was handling work on the Hudson and Manhattan Railway tubes. Then he began a consulting practice of his own in 1914, which he continued actively until a few years ago. Among his clients were the Port of New York Authority, Pennsylvania Railroad, Mexican Light and Power Company and many other utilities. His last major work was for the Pennsylvania Railroad on its tunnel under the city of Baltimore.

Mr. Forgie was also an expert witness and an arbitrator in many cases of litigation relating to tunnels.

A member of the Institution of Civil Engineers (Great Britain), Mr. Forgie was a recipient of that society's Telford Gold Medal, given for distinguished service to civil engineering.

Mr. Forgie joined the Engineering Institute in 1910 as an Associate Member, attained Life Membership in 1947.

Lieutenant Colonal Blair Ripley, C.B.E., D.S.O., M.E.I.C., consulting engineer at Oak Bay Victoria, B.C., died on July 5, 1958.

Blair Ripley was born at Oxford, N.S., on August 29, 1880. He had his education through private tuition and began his engineering career in 1897 with the Great Falls and Canada Railway and the Canadian North-West Irrigation Company. Around the turn of the century he was an assistant engineer with the G. F. and C. Railway, and during the next few years was an engineer of construction on the St. Mary's River Rly, now the C.P.R., and resident engineer of construction on the Grand Trunk Pacific Railway, C.N.R., resident engineer on viaduct construction at McLeod, Alta., and Outlook, Sask. Swinging back into Eastern Canada he was an assistant engineer with the Dominion Atlantic Railway in Nova Scotia, 1910-1912. He was an engineer of grade separation for the C.P.R. at Toronto, 1912-1915. As the commanding officer he recruited and took the First Canadian Railway Construction battalion overseas in 1916. He was awarded the C.B.E., the D.S.O., and gained mention in despatches three times for his part in the hostilities. Lt.-Col. Ripley was district engineer, Ontario district, for the C.P.R., at Toronto from 1919 to 1938 and then took over the post of engineer, maintenance of way, Eastern lines, until 1943. In 1944 he was named special engineering representative for the Toronto Terminals Railway Company.

Colonel Ripley moved to Victoria in 1945 and opened a consulting engineering practice at that time.

He joined the Institute as an Associate Member in 1907, transferred to Member in 1913, and attained Life Membership in 1943.

W. S. Wilson, M.E.I.C., chief engineer of the Dominion Steel and Coal Corporation, Limited, died at Sydney, N.S., on September 9, 1958.

Born on January 15, 1894, in Frodingham, Lincolnshire, England, Mr. Wilson came to Canada as a young man. In May, 1911 he began work with the Dominion Iron and Steel Company as a foundry helper. The following year he became a tracer and eventually a draftsman in the mechanical department sketch room.

Mr. Wilson occupied the posts of draftsman, checker, squad foreman, assistant chief draftsman, and technical engineer between the years 1917 to 1919. After a year as engineer in charge of the economy department of the Dominion Coal Company, he returned to the Dominion Iron and Steel Company in 1920 as a technical engineer. In 1930 he was named to the post of chief engineer for the company.

His final appointment as chief engineer for the Corporation was made in 1936. Mr. Wilson served under six consecutive Dosco presidents.

He also played a prominent part as consulting engineer in the promotion of the Canso Crossing project.

Mr. Wilson joined the Engineering Institute of Canada in 1921 as an Associate Member, transferred to Member in 1940 and attained Life Membership in 1957.

George Nixon Hatfield, M.E.I.C., retired street engineer with the City of Saint John, N.B., died on July 3, 1958 in that city.

Born at Saint John on May 1, 1880 Mr. Hatfield attended high school in that locality and studied engineering with the International School of Correspondence. In 1910 he accepted the post of assistant engineer with the City of Saint John. Two years later he served in the public works department, and spent some time as a road engineer with the municipal body. In 1946 he retired from active professional life.

Mr. Hatfield joined the Engineering Institute as Student Member in 1909, transferred to Associate Member in 1915, and became a Member in 1940. He attained Life Membership in 1950.

Cecil W. Fowlie, M.E.I.C., of Halifax, a member of the Federal Department of Public Works, died on July 17, 1958.

Cecil Winston Fowlie was born on August 1, 1902 at Orillia, Ontario. He had his early schooling there and then went on to Queen's University, Kingston to study engineering. In 1930 he graduated with a B.Sc. degree in civil engineering. For a number of years unable to practice due to personal affairs, he began as a field engineer in 1936 with a mining firm, later worked with the Verita Porcupine Gold Mines, the Makbodas Mining Company, Faymar Gold Mines, Hoyle Gold Mines, as an assistant engineer, between 1937 and 1943. He joined the Department of National Defence, Army, in 1943, becoming Chief Works officer and assistant to the command engineer officer. He was appointed a Member of the British Empire, in 1946. Discharged from military service in 1947, he joined the Department of Public Works at that time.

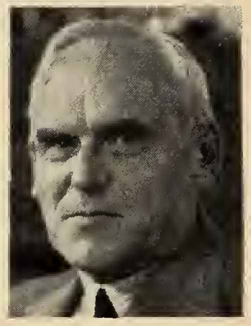
Mr. Fowlie joined the Engineering Institute as a Member in 1949.

Personals

News of the Personal Activities of Members of the Institute

R. Yuill, M.E.I.C.

R. E. Tweeddale, M.E.I.C



Rt. Hon. C. D. Howe, HON. M.E.I.C.

Rt. Hon. C. D. Howe, Hon. M.E.I.C., (B.Sc., M.I.T., 1907), formerly Minister of Trade and Commerce, member of the federal cabinet from 1935 to 1957, founder of the firm of C. D. Howe and Company at Port Arthur, was among those who received honorary degrees at Mount Allison University, Sackville, N.S., at the Centenary Convocation held August 16th, 1958. Rt. Hon. Howe was conferred an honorary doctor of laws degree in recognition of services to the state.

Russell Yuill, M.B.E., M.E.I.C., (Mount Allison; B.Sc., civil, McGill, 1915), recently retired port manager of Saint John, N.B., National Harbours Board, was conferred an honorary doctor of laws degree at Mount Allison University, Sackville, N.S., on August 16, 1958. The award was made in recognition of the part former students have played and are playing in the life of Mount Allison University.

R. E. Tweeddale, M.E.I.C., (B.Sc., elec., New Brunswick, 1935), chief engineer of the New Brunswick Electric Power Commission since 1957, has been appointed general manager of the Commission. Provision for the appointment of a general manager was made during the last session of the Legislature by amendment to the Electric Power Act. Mr. Tweeddale will however retain his responsibilities as chief engineer in addition to the top executive office.

S. G. Gamble, M.E.I.C., (R.M.C., 1932; B.Eng., civil McGill, 1933), chief topographical engineer, surveys and mapping branch, Department of Mines and Surveys, Government of Canada, has been named director of the Branch. Mr. Gamble joined the Topographical Survey of the federal government in 1946, took over the air surveys section of the Survey in 1949.

Gilbert Proulx, M.E.I.C., (B.A.Sc., civil, Ecole Polytechnique, 1941), general-superintendent of Saguenay Electric Company at Chicoutimi, Que., from 1950 to 1956, has been named president of the firm. For the past few years Mr. Proulx has been administrator of the Aluminum Company of Canada Limited, Chutes-des-Passes power project.

Gaston Dufour, M.E.I.C., (B.A.Sc., civil, Ecole Polytechnique, 1937), has been named vice-president and general manager of the Saguenay Electric Company. He was formerly works manager of the Aluminum Company of Canada smelter at Isle Maligne, Que. He has been associated with Alcan in the Saguenay since 1940.

J. N. Ford, M.E.I.C., (B.Sc., elec., Alberta, 1934), of Canadian Utilities Limited, Edmonton, Alta., manager of operations with the organization since 1956, has been named general manager of the electric utility company. Mr. Ford had early experience with Calgary Power Company and in 1951 gained the appointment of chief electrical engineer with his present employer.

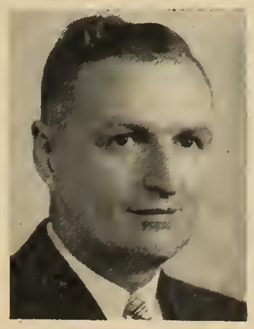
G. G. Henderson, M.E.I.C., (B.Sc., civil, Toronto, 1924), has recently been appointed general sales manager of the Canadian Bridge division of the Dominion Steel and Coal Corporation Limited. Mr. Henderson joined Canadian Bridge in 1924 and has served the company in various senior executive capacities since that time. Active in the affairs of the E.I.C., he has held office both as chairman and councillor of the Border Cities Branch.

F. J. Pollock, M.E.I.C., (B.Sc., civil, Toronto, 1922), has recently been appointed industrial and public relations manager for the Canadian Bridge division of the Dominion Steel and Coal Corporation Limited. He has been associated with the firm in various senior executive posts, most recently as operations manager.

W. R. Mitchell, M.E.I.C., (B.Sc., civil, Manitoba, 1934), contracting engineer for the Canadian Bridge division of the

F. J. Pollock, M.E.I.C.

W. R. Mitchell, M.E.I.C.



D. Scouler, Jr. M.E.I.C.

G. G. Henderson, M.E.I.C

S. G. Gamble, M.E.I.C.

Dominion Steel and Coal Corporation has been appointed chief engineer of Canadian Bridge. Mr. Mitchell joined the firm in 1940 as draftsman and design engineer and served as chief contracting engineer prior to his promotion as chief engineer.

Mr. Mitchell was elected chairman of the Border Cities Branch of the Institute in 1952, became a councillor representing the Branch in 1955.

Daniel Scouler, Jr., M.E.I.C., (B.Sc., mech., Nova Scotia Technical College, 1948), chief plant engineer for the Steel Fabrication and Manufacturing division of Dominion Steel and Coal Corporation Limited, has been appointed general manager of the Canadian Bridge division. He was formerly plant engineer for Halifax Shipyards and assistant chief engineer for Dosco.

Dr. Lyle G. Torey, M.B.E., M.E.I.C., (B.Sc., London, 1927; Ph.D., London, 1944), consulting engineer of Vancouver and Ottawa, has been retained in connection with an extensive radar air survey project of 200,000 kilometers, by the Canadian-owned Spartan Air Service Ltd., in the Zambezi Valley, Mozambique, P.E.A.

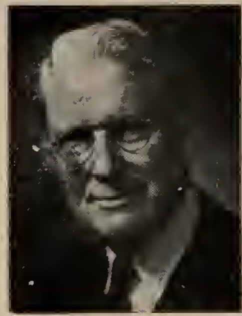
John William Southin, M.E.I.C., formerly resident engineer and resident manager, Sandwell and Company Limited, Pakistan is project engineer with Sandwell and Company Limited, Vancouver.

R. E. Crysler, M.E.I.C., (B.A.Sc., civil, Toronto, 1949), of the firm of H. A. Babcock and Company Limited, Toronto has been named a director in the organization. Mr. Crysler has had extensive experience in structural designing and municipal engineering works. He was in 1956 associated with W. S. Atkins & Associates Ltd., Toronto as a design engineer.

F. R. Murray, M.E.I.C., (B.Sc., Glasgow, civil, 1923), has been appointed Quebec sales manager for the Canadian Bridge Company and Truscon Steel, at Montreal. The announcement was made by the Dominion Steel and Coal Corporation.

Roy F. E. Bunston, M.E.I.C., (B.Sc., Queen's, 1942), has been named industrial products manager for the firm of Burndy Canada Ltd. Associated with the company since the formation of the Canadian company ten years ago, he concludes six successful years as president of Bunston Ltd., agents in B.C. and Alberta for Burndy and other electrical manufacturers.

J. E. Margison, M.E.I.C



O. Margison, M.E.I.C.

J. G. Beresford, M.E.I.C

Douglas Parent, M.E.I.C., (B Sc., mining, New Mexico, 1934), formerly manager of the Eastern Metals Corporation Limited, St. Fabien de Panet Co. Montmagny Co., Que., is general manager of the T.A.M. Company Ltd., Nigeria, West Africa. Mr. Parent has been engaged in mining projects in the province of Quebec for a number of years.

Arthur W. Harrington, M.E.I.C., (C.E., Cornell, 1909), of Ithaca, New York, has retired after more than 42 years of federal service. Mr. Harrington was, since 1921, district engineer for surface water, in charge of hydraulic and hydrologic investigational work in the State of New York for the U.S. Geological Survey, Department of the Interior.

Dr. David Silverman, M.E.I.C., (B.Sc., elec., Paris, 1935), formerly development engineer, Radio Engineering Products, Granby, Que., has taken over as senior design engineer with Henry J. Kaiser (Canada) Ltd., Montreal.

F. E. Hogg, M.E.I.C., (metall., Colorado School of Mines, 1937), assistant general technical superintendent of the Arvida works, Aluminum Company of Canada, Arvida, Que., has been named staff metallurgist with the general technical department, fabrication division of the organization at Kingston.

Mr. Hogg was secretary-treasurer of the Saguenay Branch in 1949, 1950 and 1951.

John G. Beresford, M.E.I.C., newly appointed manager of the Toronto apparatus factory, Linde Air Products Company, Division of Union Carbide Canada Limited, Toronto whose photo appears above. A "Personal" appeared in the September issue.

Col. K. H. McKibbon, M.E.I.C., (B.Sc., mech., Queen's, 1938), has taken over the post of officer in charge of administration, 4th Canadian Infantry Brigade Group, Soest, Germany. Formerly he was director of quartermaster operations and planning, army headquarters, Ottawa.

J. E. Margison, M.E.I.C., (B.A.Sc., chem., Toronto, 1942), and **Arthur G. Keith**, B.Arch., M.R.A.I.C., of Toronto, have formed a partnership for the practice of consulting engineering and architecture. Mr. Margison held industrial engineering posts with Shawinigan Chemicals Limited, Dominion Tar and Chemical Company Limited, and Merck and Company Limited. He was a director of the firm of A. D. Margison and Associates Limited. He will specialize in operations and cost reduction analysis for manufacturing firms.

Mr. Keith has served as chief architect of the Toronto Transit Commission and more recently was a director of the firm of A. D. Margison and Associates Ltd. He is colonel of the 2nd Field Engineering Regiment.

O. Margison, M.E.I.C., (B.A.Sc., civil, Toronto, 1916), formerly president of A. D. Margison and Associates Limited, has been retained as a consulting engineer with the new firm.

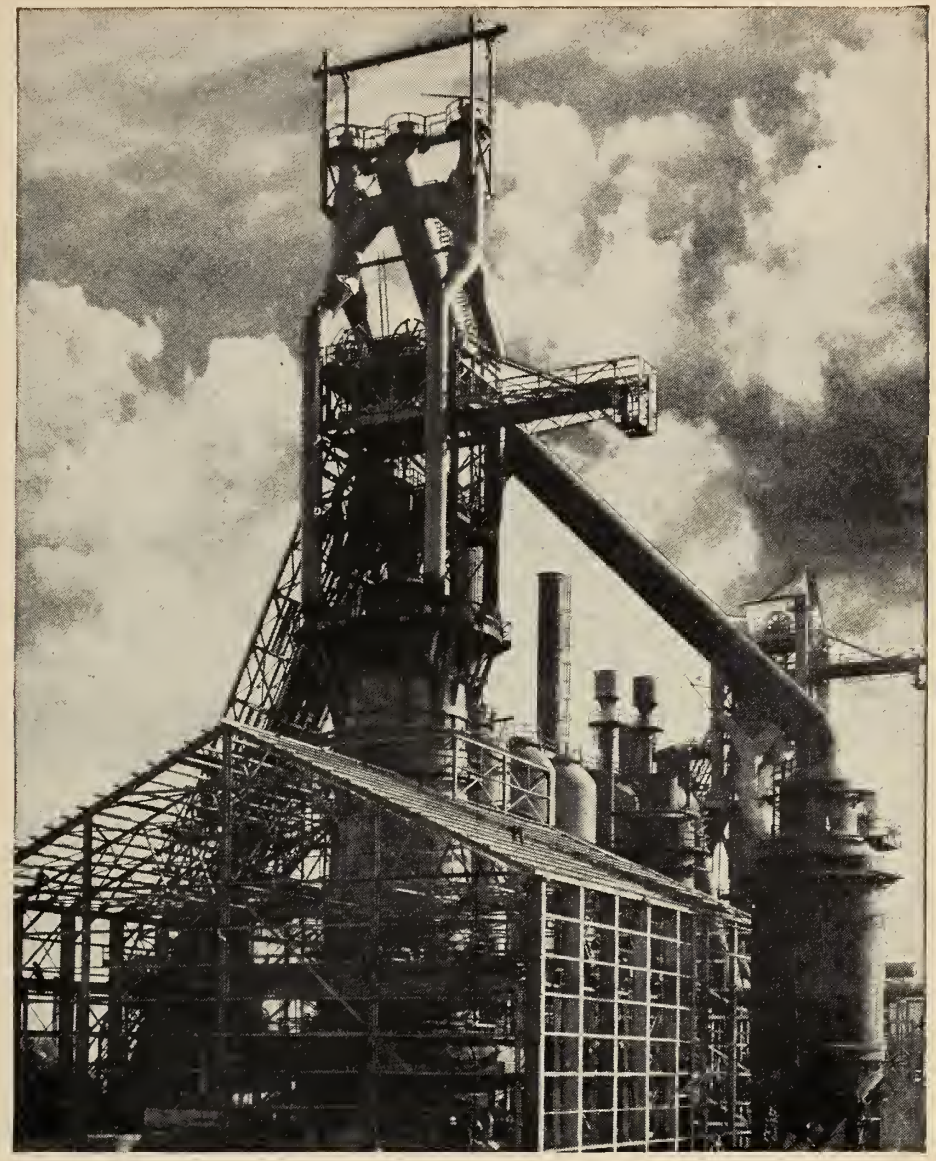
Professor J. W. Brooks, M.E.I.C., (B.Sc., civil, Queen's, 1939), associate professor of civil engineering, Queen's University, and a member of the faculty since 1947, left Kingston, Ont., with his family in August to accept an appointment at Ankara, Turkey. Granted a leave of absence from Queen's University, Professor Brooks has been commissioned by the United Nations Educational, Scientific and Cultural Organization to assist in

J. W. Southin, M.E.I.C

D. Silverman, M.E.I.C.

F. E. Hogg, M.E.I.C.

Bouquets and Blast Furnaces



The "Bouquet"

A major job, recently completed by Dominion Bridge for Dofasco's expansion programme, drew this letter: "The writer wishes . . . to thank and compliment you and your organization for the very fine manner in which the recent steel construction contract was handled . . . and delivered to us on the date asked for . . ."

The Blast Furnace

Dofasco's number two blast furnace, at Hamilton, shown above, included the uptakes, downcomer, and other intricate steelwork fabricated by Dominion Bridge.

Long experience, modern methods and continuous research are behind every job carrying the slogan—Platework by Dominion Bridge.

DOMINION BRIDGE COMPANY LIMITED. Plants at: MONTREAL • OTTAWA • TORONTO • SAULT STE. MARIE • WINNIPEG • CALGARY • VANCOUVER Assoc. Company Plants at: AMHERST, N.S.; Robb Engineering Wks., Ltd. QUEBEC: Eastern Canada Steel & Iron Wks. Ltd. WINNIPEG: Manitoba Bridge & Eng. Wks., EDMONTON: Standard Iron & Eng. Wks., Ltd.

Divisions: Platework • Boiler • Structural • Mechanical • Warehouse.

PLATEWORK BY DOMINION BRIDGE

• PERSONALS

setting up a department of civil engineering at the Middle East Technical University at Ankara. Opened in 1957, the school already has a faculty of engineering. Professor Brooks will set up a department of civil engineering, lecture, supervise research and train personnel. He is a partner in the firm of Lee & Brooks, consulting engineers, in Kingston.

Professor Brooks was chairman of the Kingston Branch E.I.C. in 1949.

John O. McCutcheon, M.E.I.C. (M.Eng., civil, McGill, 1949), formerly associate professor, department of civil engineer, McGill University, and partner, de Stein

J. O. McCutcheon, M.E.I.C.

and McCutcheon, consulting engineers, Montreal, is a principal in a new organization, "Argus Engineering and Development Limited", Vancouver. He retains his identity with de Stein and McCutcheon in Montreal.

Mr. McCutcheon served on the executive committee of the Montreal Branch E.I.C. for two years.

J. A. Campbell, M.E.I.C., (B.A.Sc., elec. eng. comm., Toronto, 1935), holds the new post of engineer of manufacture with the Northern Electric Company Limited, Montreal. He was production superintendent in 1956.

C. L. Trenholm, M.E.I.C., (B.Eng., mech., Nova Scotia Technical College, 1944),

C. L. Trenholm, M.E.I.C.

was recently elected chairman of the Moncton Branch of the Institute.

Mr. Trenholm joined Alchem Limited, Burlington, Ont., in 1947. Now he serves

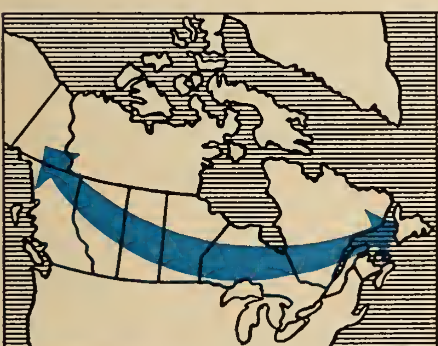
MORE POWER FOR UTILITIES

from

B & W STEAM GENERATING UNITS!

Electricity, indispensable in the life of a progressive nation, is to-day being demanded at a greater rate than ever before to satisfy the requirements of our growing population and the industries which serve it.

B & W is a major supplier of steam generating equipment for thermal power to utilities across Canada, and is constantly engaged in research and engineering development to assure continuing improvement in steam generation.



B & W UTILITY INSTALLATIONS . . . FROM COAST TO COAST

Newfoundland	—Newfoundland Light and Power Co., Ltd.
Prince Edward Island	—Maritime Electric Co., Ltd.
Nova Scotia	—Nova Scotia Light and Power Company Limited
Nova Scotia	—The Nova Scotia Power Commission
Nova Scotia	—Canada Electric Co., Limited
Ontario	—The Hydro-Electric Power Commission of Ontario
Manitoba	—City of Winnipeg Hydro-Electric System
Manitoba	—The Manitoba Hydro-Electric Board
Saskatchewan	—City of Weyburn
Saskatchewan	—City of Regina
Saskatchewan	—Saskatchewan Power Corporation
Alberta	—City of Edmonton
Alberta	—City of Lethbridge
Alberta	—Calgary Power Ltd.
N.W.T.	—Northern Canada Power Commission

BABCOCK STEAM FOR POWER

B&W CANADA STEAM

Member of Canadian Boiler Society

BABCOCK-WILCOX AND GOLDIE-McCULLOCH LIMITED, GALT, ONTARIO

MONTREAL · TORONTO · CALGARY · VANCOUVER

• PERSONALS

the Maritime and Newfoundland areas of the firm as district engineer, Moncton office. He had earlier professional experience with the New Brunswick International Paper Company in 1946, following R.C.E.M.E. service in World War II.

E. B. Broadhurst, M.E.I.C., formerly assistant to the chief engineer, Consolidated Mining and Smelting Company, at Kimberley, has accepted an appointment as superintendent of the engineering department, with Cominco.

Mr. Broadhurst was secretary of the Kootenay Branch E.I.C. in 1947-48, and chairman in 1955.

Major James H. MacLean, M.E.I.C., (B.A.Sc., mech., Toronto, 1941; M.A.Sc., Toronto, 1949), officer in charge of 200 workshops R.C.E.M.E., Halifax, N.S., has taken over the post of Army Development Establishment resident officer, Canadian Arsenals Limited, Small Arms Division, Long Branch, Ont.

Edward T. Kirkpatrick, M.E.I.C., (B.A.Sc., mech., British Columbia, 1947), has left the Carnegie Institute of Technology, Pittsburgh, Penn, and has become associated with the University of Pittsburgh, mechanical engineering department at Pittsburgh.

Albert R. Goddard, M.E.I.C., (B.Sc., civil, Manitoba, 1939), has transferred his services from the City of Winnipeg to the legal surveys branch of the Department of Mines and Resources, Ottawa. He was employed as a calculator and draughtsman in the Manitoba city.

J. W. Mason, M.E.I.C., (B.A.Sc., mech., Toronto, 1949), has accepted work as head of the turbine ship section, engineering department, H.M.C. Dockyard, Halifax. Previously he was engineer officer with H.M.C.S., Ottawa.

Harold C. Shannon, M.E.I.C., (B.Sc., civil, Alberta, 1947), of Imperial Oil Limited was recently transferred from the Edmonton to the Regina refinery and has been promoted to mechanical superintendent. Formerly assistant mechanical superintendent, he will within a short time proceed to Ioco refinery, Ioco, B.C. as mechanical superintendent.

Captain K. L. F. Coupland, M.E.I.C., (B.Sc., mech., Queen's, 1948), recently returned to Canada from Great Britain.

Now stationed at Calgary, Captain Coupland is second-in-command with No. 1 Infantry Workshop, R.C.E.M.E., which unit has recently relocated from Kingston, Ont.

W. D. Mackinnon, M.E.I.C., (B.Sc., civil, Manitoba, 1941), of Port Arthur, Ont., is chairman of the Lakehead Branch of the Institute. Mr. Mackinnon is a member of the Lakehead Technical Institute, Port Arthur, Ont. Early in his career he was associated with the water resources branch, Province of Manitoba, and the C. D. Howe Company of Port Arthur.

D. W. Harvey, M.E.I.C., (B.Sc., civil, Alberta, 1951), has left the post of project engineer and estimator with Walsh-Canadian Construction in order to accept employment with the Canadian National Railways as a construction engineer at St. Bruno, Que.

Robert E. Johnson, M.E.I.C., (B.A.Sc., civil, Manitoba, 1947), has transferred

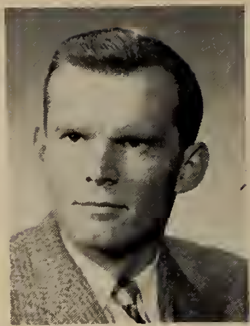
W. D. Mackinnon, M.E.I.C.

his services from Ontario to British Columbia. In his new professional association, he is project engineer with the British Columbia Power Commission at Victoria, B.C. Previously he was hydraulic model engineer with the Hydro-Electric Power Commission of Ontario, at the Islington Hydraulic Laboratory.

W. A. McLaughlin, M.E.I.C., (B.Sc., civil, Saskatchewan, 1951; M.S.C.E., Purdue, 1958), division engineer with the Saskatchewan Department of Highways in charge of all construction within the Tisdale division, has been promoted to senior traffic engineer with the Saskatchewan Department of Highways at Regina, Sask.

J. P. Walsh, M.E.I.C., (B.Sc., civil, Alberta, 1951), has moved from Alberta to the Northwest Territories. Mr. Walsh who was a district construction engineer with Mobil Oil of Canada, Drayton Valley, Alta., in his northern location is area engineer with the Department of Public Works of Canada, highway division.

Eric C. Scott, J.R.E.I.C., (B.A.Sc., civil, Toronto, 1949), has accepted the appointment as engineering officer with the Industrial Development Bank at head office, Montreal. Mr. Scott was formerly staple fibre plant supervisor with the Canadian Industries Limited "Terelene" plant, at Millhaven, Ont.



E. C. Scott, JR.E.I.C

C. V. Davies, JR.E.I.C.

J. A. Dubuc, JR.E.I.C.

Jacques A. Dubuc, J.R.E.I.C., (B.Eng., elec., McGill, 1953), of James H. Wilson Limited, Montreal has left his post as chief engineer to become manager of the newly formed equipment division of the firm at Roxboro, Que. Mr. Dubuc was vice-chairman of the junior section, Montreal Branch E.I.C. in 1958.

C. V. Davies, JR.E.I.C., (B.Sc., civil, Queen's, 1947), erection engineer for the Canadian Bridge division of the Dominion Steel and Coal Corporation Limited, has been appointed assistant general manager of that division. With Canadian Bridge since his graduation he served as a design engineer and assistant engineer of erection before being promoted to erection manager.

R. R. Ritchie, JR.E.I.C., (B.Sc., elec., New Brunswick, 1947), of Fredericton, N.B., is president of the Maritime Design Consultants Ltd., in that city. He formerly held the post of vice-president of C. W. Ritchie and Sons Ltd., at Fredericton from 1956 to 1958. Earlier in his career he gained experience with the Montreal Engineering Company Ltd., Montreal and with Calgary Power Limited, Calgary.

N. P. Wallace, JR.E.I.C., (B.Eng., mech., Nova Scotia Technical College, 1949), has been named to the post of industrial engineer with the Dominion Steel and Coal Corporation.

Ian Broadbent, JR.E.I.C., (B.Eng., civil, McGill, 1952), of Montreal, has been

• PERSONALS

named executive engineer with the Dominion Steel and Coal Corporation, Montreal. Mr. Broadbent has served Dosco for a number of years.

Eric Mercer, J.R.E.I.C., (B.Eng., civil, N.S.T.C., 1952), resident engineer on water and sewage installation at Windsor, Nfld., has accepted an appointment as local government engineer, Department of Municipal Affairs and Supply, Nfld.

Eric G. Hale, J.R.E.I.C., (B.Sc., mech., Saskatchewan, 1948), of Timber Preservers Limited, Toronto, has been transferred to New Westminister, B.C. as chief estimator for the organization. While in Eastern Canada, Mr. Hale was manager of the Toronto office of the firm.

Arthur de Breyne, J.R.E.I.C., (B.Eng., mech., McGill, 1949), a member of the firm of The Ventilating and Blow Pipe Company Limited, St. Lambert, Que., since 1950 is secretary-treasurer and engineer of the organization.

He is 1958-59 president of the Montreal Chapter of the American Society of Heating and Air Conditioning Engineers.

Stanley Nowak, J.R.E.I.C., (B.Eng., elec., McGill, 1950), of the Falconbridge Nickel Mines, Onaping, Ont., has been promoted from assistant chief electrician to chief electrician.

W. G. Lancaster, J.R.E.I.C., (B.A.Sc., mech., U.B.C., 1950), has transferred his services from the Ford Motor Company of Canada, Windsor, Ont., to the Dominion Bridge Company in Calgary. Formerly employed as a field engineer his present work is that of mechanical design engineer.

Marcel Bourque, J.R.E.I.C., (B.Eng., civil, McGill, 1951), an associate of the Sherbrooke, Que., firm of Cote-Lemieux-Carigan and Bourque, consulting engineers, and in addition to this professional association, Mr. Bourque now represents the office in the new firm of Cartier Cote Piette.

Donald J. Ross, J.R.E.I.C., (B.Sc., civil, McGill, 1951), formerly field engineer with Interprovincial Pipe Line Company, Sarnia, Ont., has been transferred to head office of the firm at Edmonton, on completion of work in Ontario. He was engaged in building an electrical pump station to move crude oil from Sarnia to Clarkson and Port Credit refineries.

E. Lundy Pearson, J.R.E.I.C., (B.Sc., mech., Manitoba, 1953), and former Athlone Fellow, 1954-1956, has been transferred from sales development office of Canadian Industries Limited in Montreal, to the mechanical development ammunition division at Brownsburg, Que. with the duties of project engineer.

William A. Johnson, J.R.E.I.C., (B.Sc., C.E., Manitoba, 1952), of the firm of C. A. Pitts General Contractors Limited, project engineer at the Laurie River Power Development, #2 in Northern Manitoba, has taken over the duties of job superintendent on highway construction for the company at Magpie, Ont.

William D. West, J.R.E.I.C., (B.Sc., elec., Queen's, 1955), formerly a lieutenant (L) Royal Canadian Navy, electrical officer of Helicopter Anti-Submarine Squadron Fifty, is now engineer with R.C.A. Victor general service department, Montreal.

C. K. A. Stieda, J.R.E.I.C., (B.Sc., civil, Manitoba, 1955; M.Sc., Alberta, 1958), assistant to the building superintendent, University of Alberta, has taken on the duties of forestry officer with the Forests Products Laboratory timber mechanics section, Ottawa. His work involves research into wood structures.

John E. Thomlinson, J.R.E.I.C., (B.A.Sc., elec., Toronto, 1955), of the Hydro-Electric Power Commission of Ontario, formerly assistant to the area manager, Norwood R.O.A., has become assistant manager, Peterborough R.O.A., at Peterborough, Ont.

T. J. McDonald, S.E.I.C., (B.E., elec., N.S.T.C., 1958), has accepted a post with the Northern Electric Company Limited, engineering department, in Montreal.

John Alexander Watson, S.E.I.C., (B.A.Sc., civil, U.B.C., 1958), has accepted work as a transitman for the Canadian Pacific Railway Company at Medicine Hat, Alta.

Kelvin Bellis, S.E.I.C., (B.A.Sc., mech., Western Ontario, 1958), has found employment with the Pratt and Whitney Aircraft Company, Longueuil, Que. Presently taking part in a training program, his work will be that of design engineer.

C. L. Papenhuyzen, S.E.I.C., (B.Eng., mech., McGill, 1957), test course engineer with Canadian General Electric Company Limited, Peterborough, Ont., has taken over the post of plant engineer with Asten-Hill Limited, Valleyfield, Que.

Clement Crepin, S.E.I.C., (B.Sc., mech., Laval, 1958), has found employment with the Canadian Westinghouse Company Limited, at Hamilton, Ont.

F. W. Meyers, S.E.I.C., (B.Sc., elec., Queen's, 1955), formerly communications officer, R.C.A.F. Station Falconbridge, Ont., has taken over the post of Station Telecommunications officer, R.C.A.F. Station, Foymount, Ont.

Fernand Leduc, S.E.I.C., (B.Sc., A., mining, Montreal, 1958), is at present in the employ of the City of Montreal, waterworks department.

...ys a big part in St. Lawrence Power Project

For the St. Lawrence Power Project English Electric are supplying

. . . for the Generating Station—

all sixteen of the 75,000 H.P. turbines that will provide the whole of Canada's share of the power from this international project.

also the control metering and relaying equipment. This equipment located in the main control room, and other parts throughout the powerhouse will form the 'nerve centre' of the whole station, and will control the main functions of normal operations. English Electric relays are used extensively to protect against, or warn of, abnormal conditions.

. . . for the Transformer Station—

two 115,000 KVA auto transformers, and six 46 Kv, 1000 MVA outdoor oil circuit breakers.

ENGLISH ELECTRIC' CANADA

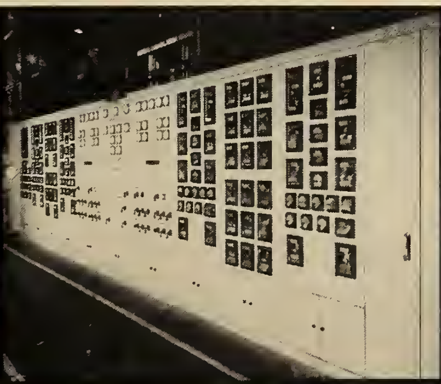
HYDRAULIC TURBINES
CONTROL SWITCHGEAR
POWER TRANSFORMERS

...NGLISH ELECTRIC CANADA, A DIVISION OF JOHN INGLIS CO. LIMITED

ST. CATHARINES, MONTREAL, OTTAWA, TORONTO, WINNIPEG, CALGARY, EDMONTON, VANCOUVER AND HALIFAX

93

...e of sixteen 75,000 H.P. English ...ectric fixed blade propeller runners ...sembled with turbine covers, being ...t into position.



Four of these English Electric duplex boards are installed in the Generating Station. Each board incorporates the relays and instruments for four generators.

Three of six 46 Kv, 1000 MVA outdoor oil circuit breakers in the transformer station.

NEWS OF THE BRANCHES

Activities of the Fifty Branches of the Institute and abstracts of the papers presented at their meetings

HAMILTON

W. A. H. Filer, JR.E.I.C., *Sec.-Treas.*

THE PROFESSIONAL DEVELOPMENT program registration night held September 17, opened another season of the largest P.D. program in operation in Canada.

J. A. Walsworth, JR.E.I.C., director of the four year P.D.P., first organized in 1951, had this to say as an opening remark: "Possibly the greatest failing of the Canadian professional engineer is his lack of pride in himself and his chosen profession. For too many years in the past the engineer has been interested in mending only his own personal fence and has said in effect, 'to hell' with the rest of society." Mr. Walsworth said that the most important fact to bear in mind, however, was that the P.D.P. has the objective of developing the engineer to better fit him for the responsibilities of his profession. These, he said, were: to expand and develop his fund of knowledge for his own betterment; to better understand and handle the problems that arise in day to day work for his employer; guarantee that an engineering theory will not be permitted to develop into a monster. An attempt is made, he said, to cover these points in the four-year program. Sufficient emphasis had not yet been given to the last point, however, which relates the matter of responsibility to the engineering profession in assisting in its expansion and growth.

New Plans Outlined

Mr. Walsworth outlined new plans which had been put into effect in aiding the development of the engineer. An Engineers Reading List prepared by the 1957 directorate is available.

A personal self-appraisal form has top priority in P.D.P. plans. It is hoped the forms will be available this year. A "Big Brother" movement has been planned with the idea of advising and encouraging these young men on a personal basis. This is to be executed with the help of the alumni group of 150 men and will be carried out at McMaster University.

Counselling will be carried on in the high schools, as in other years on a personal basis.

The objective of the P.D.P., as outlined in Article 2 of the constitution of the organization, he said, was the development of engineers through a comprehensive program of study, lectures and discussions; thereby better fitting them for the responsibilities of their profession. The means, he said, were as follows: by instruction in non-technical subjects through lectures, discussion periods, group presentations and case studies; by obtaining recognized authorities in non-technical fields to present these topics; by stressing individual participation in organizing and operating the program and in discussion periods; by providing a place where individuals may meet and become acquainted with their professional contemporaries.

Mr. Walsworth also urged flexibility in the program, urging members to suggest changes deemed necessary.

Industry, he said, had indicated a great interest in the program in supplying speakers and in showing interest in their own members who took part in the program.

Program Directors and Guests

Members of the executive of the program who will direct the operations of the program are: immediate past director, Ken Crean; secretary, Jim Nisbet; treasurer and caretaker-chairman gr. 1, Ed. Borza; chairman gr. 2, Doug Pearson; chairman gr. 3, John Bailey; and chairman gr. 4, Bob Payton.

Mr. Walsworth introduced two men who, he said, were outstanding and had been greatly instrumental in bringing the program to its present successful state. They were the first director and E.I.C. representative on the E.C.P.D. training committee, G. L. Schneider, and W. A. H. Filer, past director and chairman of the P.D.P. National Co-ordinating committee. Also present for the registration night was W. Lardner, director of P.D.P. in Toronto and representatives from interested engineering groups. Colonel T. N. Medland, executive director of the Association of Professional Engineers of Ontario was among the guests. Others were R. C. Mitchell, Hamilton Branch chairman, E.I.C., H. P. Gatin, director of membership service, E.I.C. headquarters, Montreal, and J. A. MacLaren, Eastern field secretary, E.I.C., Toronto.

LONDON

W. C. Sinkins, JR.E.I.C., *Sec.-Treas.*

G. W. Chorley, M.E.I.C., *Branch News Correspondent*

A PANEL DISCUSSION on "London's Water Supply" heard at the London Branch meeting held September 16 was very well attended. Speakers were A. Furanna, assistant general manager, Public Utilities Commission; L. Johnson, sec.-treas., Upper Thames River Conservation Authority; and W. McNaughton, assistant engineer, U.T.R.C.A.

Opening the discussion, Mr. Johnson described the work done by the Upper Thames River Conservation Authority in conservation, flood control, water supply and control of pollution. Future plans for the north branch of the Thames call for dams at Wildwood and Glengowan. Dams for the south branch will be located at Woodstock, Cedar Creek and Thamesford. With these dams it will be possible to increase the minimum flow through London from 20 million g.p.d. to 180 million g.p.d.

Mr. McNaughton, who operates the dam at Fanshawe, north of London, described the operation of the dam for flood control purposes.

Third member of the panel, A. Furanna, outlined the history of water supply developments in recent years in London. Referring to the 1954 engineers report, Mr. Furanna pointed out that it recommended using, a) deep well water b) surface water at Fanshawe and c) Great Lakes water, in that order of preference. At the present time, water is being pumped out of Fanshawe Lake into natural kettles. It is being recovered from nearby deep wells at the rate of 4 to 5 million g.p.d. A proposed filtration plant at Fanshawe for 6 million g.p.d. is at present held up by lack of approval from the Ontario Water Resources Committee. This approval is being withheld

subject to the City of London improving its sewage disposal facilities. Mr. Furanna went on to explain what work had been done investigating pipe lines from either Lake Huron or Lake Erie.

Considerable discussion ensued on the sources of water supply for London. Mr. Miller, ex-city engineer, St. Thomas, Ont., described his experience with surface water in the last thirty-eight years. Speaking out strongly in favour of using surface water for London, E. V. Buchanan said, "London needs a pipeline as much as Egypt needs another pyramid!"

MONTREAL

G. M. Boissoneult, JR.E.I.C., *Sec.-Treas.*

J. Turner Bone, JR.E.I.C., *Entertainment Committee Chairman*

THE FOURTEENTH ANNUAL DANCE for the Junior Section of the Montreal Branch of the Engineering Institute will be held at the Windsor Hotel, Montreal, Friday, November 7.

Due to the large turn-out last year, the entertainment committee has secured more spacious accommodations so that there will be more room to dance. Both the ballroom and the Rose room have been reserved for this popular event. Members are urged to attend.

The Annual Spring cocktail party, 1958, was held at the Berkeley Hotel, Montreal, early in the month of June. This event was a success although space permitted a larger attendance. It is hoped that in 1959 more of the young juniors of the section will participate in the event.

NORTHERN NEW BRUNSWICK

S. K. Henry, JR.E.I.C., *Sec.-Treas., and Branch News Reporter*

THE SIXTH ANNUAL DINNER meeting of the Branch was held at the Country Club at Dalhousie on June 6. Fifty-five members and guests including the ladies attended. Cocktails, a lobster and turkey dinner preceded a short business meeting.

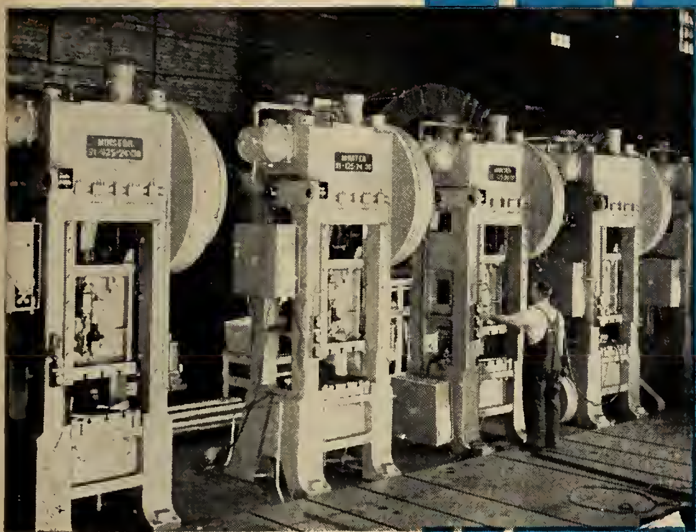
Elected chairman was D. C. MacCallum, vice-chairman, J. A. Mersereau; and secretary-treas., S. K. Henry. Executive members are K. A. W. MacDonald, T. H. McSorley, of Restigouche Co.; Peter Dallien, P. J. Delicaet, Gloucester Co.; and F. B. Ervine of Northumberland Co.

Outgoing chairman L. L. Marshall thanked the retiring executive for their co-operation and the members for their interest in the events of the year. D. C. MacCallum was then introduced and took the chair.

Regional Meteorologist Speaks

E. A. Barks, regional meteorologist of the Atlantic Provinces outlined the de-

- for metals processing
- for the mining industry
- for pulp and paper mills
- for the steel industry



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Sales Offices Montreal: 921 Sun Life Building, UNiversity 6-7841 • Toronto: 169 Eastern Avenue, EMpire 3-8801 velopment of weather forecasting in which he covered the growth and scope of the weather services of Canada. He pointed out that weather forecasting on an organized basis was started about 100 years ago, with the aid of the telegraph. In the past years aviation forecasting has become the most important weather service. Mr. Barks emphasized the fact that weather forecasting is a service and expands according to the needs and demands of the country.

Dancing was enjoyed at the close of the sixth annual dinner meeting.

TORONTO

D. S. Moyer, JR.E.I.C., *Sec.-Treas.*

G. F. R. Norton, JR.E.I.C., *Branch News Reporter*

A PLANT VISIT to Avro Aircraft Limited at Malton, Ont., arranged by I. S. Gauley, chairman of the Junior activities' committees, concluded the spring program of the Toronto Branch of the E.I.C. Although an attendance of 200 was anticipated, all tickets were disposed of on the day they were issued. As a result Avro increased reception facilities and accommodated nearly 300 members of the branch.

In the well-filled company cafeteria, R. Adey, chief administrative engineer, briefly outlined some of the achievements of Avro since taking over from Victory Aircraft in 1946. These included producing the first Jetliner in North America; design and production of the CF-100 interceptor now employed in the R.C.A.F., Belgian and NATO forces, and more recently producing the already famous supersonic interceptor, the Avro Arrow. He emphasized that the Arrow was an integral part of a weapon system designed to receive attack information, despatch and control the Arrow to repel the attack, then return it to base and restore it to readiness for further study.

The introduction to the reason for the Arrow was followed by a film. This showed how the problem of flutter of various components had been studied and conquered using models under test in the wind tunnel of the National Research Council. Then the production departments were visited. These included detail and assembly shops, the flight line, the repair and overhaul line, and the final assembly line. Probably the most impressive single operation was skin milling, that is, the routing of wing surfaces with integral stiffeners out of great slabs of aluminum alloy.

After the visit to the production departments, the film of the first flight of the Arrow was shown. Then followed coffee and questions. It was pointed out that 17,000 drawings were required for the 38,000 parts of the aircraft, and that the initial drawing releases were for production tooling.

● BRANCH NEWS

At the end of a three-hour visit the Branch was able to compliment Avro on their remarkable achievements of forward thought and action in the field of aircraft production, and to thank them for their exceptional hospitality.

WINNIPEG

Professional Engineers' Wives Association

The Professional Engineers' Wives Association completed its eighteenth year in Winnipeg with a high record of membership, achievement, activity and general sense of friendship.

The highlight of each session is the visit of the wife of the president of the E.I.C. In April, members enjoyed a coffee party to meet Mrs. C. M. Anson, and later in the day the executive and committee held a sherry party and dinner at the Winnipeg Winter Club.

The fall membership rally tea, Christmas shower tea for tubercular patients, a dessert party, a tea meeting with a speaker, and the very successful money-making coffee party held at the Hudson's Bay Company's Beaver Hall, rounded out the season with regular business meetings, after luncheon and guest speakers. Get-acquainted evenings have been held for three seasons and this year were arranged for member-interests. Eight members opened their homes for bridge, music, games and crafts in March.

Two bursaries of $100.00, sponsored by the group, for engineering students in the University of Manitoba may receive some change in form and amount of cash given. One bursary is self-supporting at the present time.

The members feel a real sense of pride in the organization for it is recognized in Winnipeg for its purpose and good program and is now affiliated with the Winnipeg Council of Women and the Canadian Association of Consumers.

UPADI Convention *(continued from page 98)*

Status of Engineering in the U.S.A.

Ralph A. Morgen of Purdue Research Foundation, Purdue University, Lafayette, Indiana, reported to UPADI that there are 221 institutions of higher learning offering engineering degrees in the U.S., and it is expected that the total enrolment this fall will be in excess of 300,000.

Slightly more than half of these institutions are publicly controlled institutions. The shift from predominantly privately supported engineering education to a majority support by public institutions and the tremendous growth in the need for graduate education in engineering are two of the major factors in the status of engineering education in the U.S.A.

Of the 221 institutions which offer undergraduate engineering degrees at the bachelor's level, 153 have one or more accredited programs. Those offering advanced degrees are virtually the same as those with accredited programs. This is significant in Mr. Morgen's opinion.

Prior to the Wickenden reports of the 1920's an engineer was thought of as a high-grade technician. The reports recommended that a liberal amount of study in the humanities be included in engineering education; this was a first step in making engineering a broad professional subject. But the question still remains unanswered; "how much theory and how much practice, in how much time, can be included in any engineering curriculum?

The next logical step after the Wickenden Reports was a concerted program of accreditation for all engineering curricula. The registration laws also called for proper classification. The engineering societies co-operating, E.C.P.D., the Engineers' Council for Professional Development was established in 1932. One of the aims of E.C.P.D. was to provide criteria for colleges of engineering to insure graduates with sound educational foundation," developed into the accreditation program of E.C.P.D. Accreditation was to be by specific curricula rather than by accreditation of an engineering college as a whole. The American Society of Engineering Education made a study for E.C.P.D., and the Society's committee on the Evaluation of Engineering Education issued a report in 1955. Recommendations made included strengthening the basic sciences; identification and inclusion of six engineering sciences; integrated study of engineering analysis, design and engineering systems; the inclusion of elective subjects to develop the special talents of individual students, to provide flexibility; strengthening of humanistic and social sciences in the curriculum; development of the oral, written and graphic communication of ideas; encouragement of experiments; strengthening of graduate programs to provide a specially qualified faculty, to attract students of superior ability, and furnish adequate financial and administrative support; positive steps to insure the maintenance of faculties with the intellectual capacity as well as scholarly attainments.

(Continued on page 132)

• UPADI CONVENTION

(Continued from page 130)

Mr. Morgen listed three "inescapable conclusions," regarding the course of engineering education in the U.S.A.; 1) Technological progress and increasing education in the U.S.A.; larger percentages of technically trained and engineering-trained employees; larger output by universities will be required. 2) The quickening pace of technical development has resulted in an increase in research and development effort, and the need for men educated to master's level for development and higher level design work. 3) Need for 1000 engineering teachers a year for the next ten years, the majority with a doctorate in engineering. Industry requires the same number of Ph.D.'s in engineering per year. Doctorates are now granted to about 600 a year, and only ten per cent select university positions.

Engineering Education in Brazil

Professor Octavio Cantahede of Brazil said that teaching at the higher levels in Brazil is orientated and controlled by the government, through the Ministry of Education and Culture.

Between 1930 and 1957, the number of schools of engineering, architecture, and chemistry increased by 100%, but facilities are still inadequate, he said. Today, 25 schools, scattered over the different states, serve a student population of 10,000. Of this number, 2,000 graduate in engineering and architecture.

The setting up of schools specializing in aeronautical problems and aircraft construction, new courses in electronics, telecommunications, naval construction and others all bear witness to the degree in which Brazilian teaching processes and education are advancing with the times. Methods for the better orientation of the technological instruction problems are being studied, he said.

Due to immense industrialization in Brazil there is a growing need for engineering technicians as well as for engineers. Present ratio of technicians to engineers is 0.8 to 1; engineers to labourers, about 4 to 1000.

A vast program for enlargement and improvement of educational facilities was drawn up in 1957 by the Ministry of Culture and Education. Covering primary, secondary, professional and rural teaching, the plan will encompass the entire educational system and will be interwoven in the Law of Directives and Bases of Brazilian education. Two special steps were taken in regard to engineering education: the establishment of diverse technological institutes; and the enlargement of engineering schools.

Notable among other measures under study is the project establishing the National Bank of Education, S/A, which will attend entirely to the problem of finance. This solution would bring to an end one of the greatest problems of Brazilian educational authorities.

Engineering Education in Mexico

Rodolfo Felix Valdes, of the National School of Engineers, National University of Mexico, spoke on Engineering Education in Mexico. He said that the rapid progress of present day development in Mexico requires the availability of well-trained engineers, capable of assuming very important duties. Mr. Valdes reported the plan which was accepted by the First National Congress of Engineering Schools and Faculties, held in Monterrey, in April, 1958.

Prime considerations in the teaching of engineering in Mexico are: the plan of study, co-ordination of courses, the problem of enrolment; and the numbers who drop out of school. Two classes of subjects are: basic or preparatory courses; and professional courses. Two years are devoted to the study of basic subjects generally. Three years are considered necessary for the study of professional courses, with a program adjusted according to the development of the geographic region in which a student has the most probability of practising his profession, and at the same time providing a sufficiently broad background to enable him to practice in other regions and in other branches of engineering.

The regional needs and academic problems are related and the co-operation of the professors indispensible.

Also recommended is the provision of facilities allowing teachers to gain master's and doctor's degrees and by personal research and progress, help their students.

Mexico has enrolment problems, such as crowding in schools in the capital city, while local schools are uncrowded; and also the problem of too large a percentage of students dropping out of university. Both of these difficulties should be studied.

News of Other Societies

National Nothern Development Meeting

The National Northern Development Conference, sponsored by the Edmonton Chamber of Commerce and the Alberta and Northwest Chamber of Mines and Resources was held at Edmonton, September 17-19, 1958.

General chairman of the event was E. K. Cumming, of Cumming Galbraith and Company. Welcome to the delegates to the convention was expressed by C. W. Carry, president of the Edmonton Chamber of Commerce.

Also at the opening session there were greetings from W. V. Wilkin, president of the Alberta and Northwest Chamber of Mines and Resources.

The program consisted of four panel discussions, as follows:

Potential Northern Development—an inventory of present and potential development of northern Canada as related to the further economic development of North America.

Teamwork for development—an outline of the parts to be played by government, industry and finance, in the development of Northern Canada.

Planning Northern Development — the necessity of replanning the orderly development of the north.

Living in the North—the problems of northern living and their solution.

During the proceedings a joint luncheon was held with the Edmonton Rotary Club and addressed by guest speaker G. L. McMahon, Calgary, president of Pacific Petroleums Ltd.

At a banquet provided by the Province of Alberta, the Hon. E. C. Manning, premier of the Province of Alberta was guest speaker.

On the closing day of the proccedings, His Worship Mayor William Hawrelak was guest speaker at a noon luncheon. The City of Edmonton played host on this occasion.

Concluding the conference, delegates took part in the post conference air tour to the Yukon and Alaska with stop-overs at Whitehorse, Y.T., Fairbanks and Anchorage, Alaska.

C. C. A. Housing Conference

The Canadian Construction Association housing conference held in June in Ottawa, laid emphasis on ways and means of increasing the opportunities of improved housing for the under-5,000-a-year income group. It was a follow-up of a preliminary conference last November. Representative of the E.I.C. was J. H. Irvine, of Ottawa.

Recent developments relating to the low rental housing were reviewed. A paper was presented on "The Overall Cost of Housing" by R. F. Legget. The lower-cost housing market, and the necessary factors for a lower-cost, long-term housing program, were discussed by the delegates.

The opinion emerged that factors of land cost and availability were in general more of a problem than actual construction costs and, at the time, the availability of mortgage funds. Higher housing densities in land-poor metropolitan areas were desirable in many areas because of the relative shortage of serviced land and the problems of urban sprawl.

Resolutions was adopted urging that the Federal Government give consideration to altering its policy whereby agency loans for low-cost rental units had been discontinued, and recommending N.H.A. financial assistance for the installation feeder water-mains and trunk sewers on low-cost housing areas.

Among other conclusions and recommendations agreed upon were the following:

The outlook for large housing programs was encouraging, with three million units needed in the next decade or two. There were examples whereby conventional methods can produce a three-bedroom house for persons with incomes as low as $300 a month in areas with moderate land costs. Technically, Canadian methods compared favourably with those of other countries.

Society of Chemical Industry

Approximately 44 leaders of the chemical industries of Great Britain, the United States and Canada converged on eastern Canada for the annual general meeting of the Society of Chemical Industry and a program of visits and plant tours to major centres in Quebec and Ontario, September 11-23, 1958.

The president of the Society of Chemical Industry is H. Greville Smith, president of Canadian Industries Limited. He is the first Canadian to hold this position in the past twenty years, while Dr. R. S. Jane, president of Shawinigan Chemicals Limited, is president of the Canadian section.

Sessions of the annual conference were held at Montreal on September 14 and 15, and in Toronto, September 17 and 18. Preceding and following the sessions, visits and plant tours were made to seven cities, including Quebec City, Shawinigan, Sarnia, Niagara Falls, and Ottawa.

The Messel Medal of the Society for the first time presented to a Canadian, was awarded to the Rt. Hon. C. D. Howe. It was given for meritorius distinction in science, industry, or public affairs.

The U.S. section of the society presented its chemical industry medal to Fred J. Emmerich, past-chairman of the board of Allied Chemical Corporation. The medal was awarded for conspicuous services to applied chemistry.

NOTICES

Canadian Lecturer

The honour of giving the British Commonwealth Lecture in 1958, one of the annual highlights of the Royal Aeronautical Society, went to James C. Floyd, vice-president, Engineering, Avro Aircraft Limited, Malton, Ontario, on October 9. In accepting the Society's invitation to address the most famous aeronautical personalities in Commonwealth aviation, Mr. Floyd has joined an impressive role of speakers, including the Duke of Edinburgh, the 1954 speaker.

Coal Research Conference

The tenth annual conference of the Dominion-Provincial Committee on Coal Research was held September 1 and 2, 1958, at the Algonquin Hotel at St. Andrews, N.B.

As has been the custom in the past the Coal Research group meets just prior to the Mines Ministers' Conference which this years was held at the Algonquin Hotel also, September 3 to 5, 1958.

The Committee on Coal Research tries at its annual meeting to bring forward items of interest, both to producers and users of coal throughout Canada.

OFFICERS

A.S.M.E. Election

Glenn B. Warren, vice-president and consulting engineer of the turbine division, General Electric Company, has been elected president of The American Society of Mechanical Engineers for a one-year term. Mr. Warren has been active in turbine generator design, development and manufacture, particularly for electric power generation, throughout his engineering career. General manager of General Electric's turbine division from 1949-1957, Mr. Warren is now responsible for formulating and establishing long-range engineering and products plans for the division.

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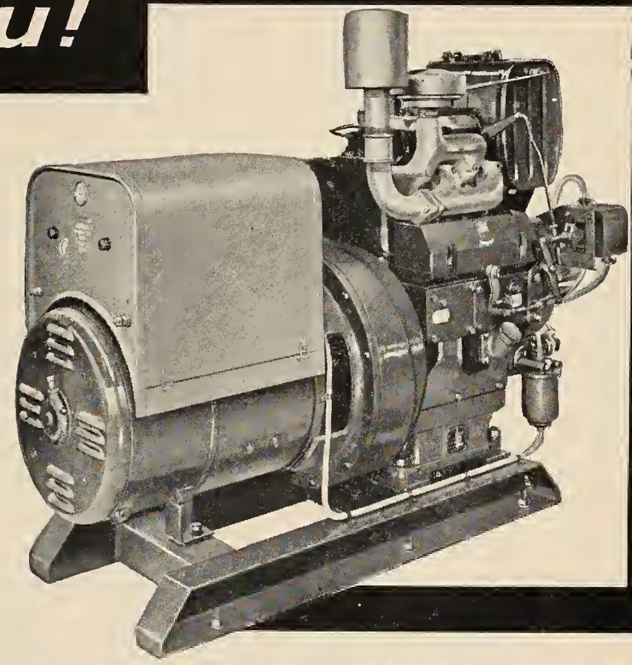

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• OTHER SOCIETIES

C.I.C. Appointment

T. H. G. Michael, general manager and secretary of The Chemical Institute of Canada has announced the appointment of D. W. Emmerson, as editor of the news-technical journal, Chemistry in Canada.

Calendar

Chemical Institute of Canada

"Canada's Export Trade in Chemicals" will be the theme of the Chemical Institute of Canada Chemical Economics Division meeting on November 18, 1958 at the Sheraton-Mount Royal Hotel, Montreal.

The opportunities in the export field and the experience of Canadian companies active in it will be examined in detail at this full-day session.

The opening address by the chairman and founder of the Division, Rhys D. Bevan, will set the stage for panel discussions between government and industry experts.

The broad aspects of international trade and the factors influencing chemical export opportunities will be handled by a panel including members of the Trade Commissioner Service and International Trade Relations Branch of the Department of Trade and Commerce. The British Commonwealth, Latin America and the Far East will be the main target areas for this panel. Senior executives of Canadian chemical companies will present case histories of their operations in the export field to demonstrate the opportunities and pitfalls. An important feature of this meeting will be the dinner address by A. A. Thornbrough, president, Massey-Ferguson Limited.

Those interested should contact J. R. Charlton, Canadian Curtiss-Wright Limited, 1980 Sherbrooke St. W., Montreal.

Public Works Congress

Public Works and Municipal Services Congress and Exhibition. Olympia, London, England, Nov. 10-15, 1958.

The Society of the Plastics Industry, Inc.

Eighth National Plastics Exposition. International Amphitheatre, Chicago, Ill., Nov. 17-21. Concurrently, the National Plastics Conference, Hotel Morrison.

Operations Research Society of America

Fourteenth National Meeting, Saint Louis, Mo. Oct. 23-24, 1958. Statler Hotel.

Society for Experimental Stress Analysis

1958 Annual Meeting. Sheraton-Ten-Eyck Hotel, Albany, New York.

American Society of Civil Engineers

Conference on Electrical Computation, Kansas City, Mo., Nov. 20-21, 1958.

Steel Founders' Society of America

Thirteenth Technical and Operating Conference. Carter Hotel, Cleveland, Ohio, Nov. 10-12, 1958.

National Association of Corrosion Engineers

Western Region Meeting. Los Angeles, Nov. 17-19, 1958.

The Society of the Plastics Industry, Inc.

Eighth National Plastics Exposition, Annual Plastics Conference. International Amphitheatre, Chicago, Ill.

Institute of Traffic Engineers

Twenty-Eighth Annual Meeting. Deavuille Hotel, Miami Beach, Florida, Nov. 11-13, 1958.

Electronic Engineering Association and Office Appliance and Business Equipment Trades Association.

Computer Exhibition and Business Symposium, Olympia, London, Nov. 28 to Dec. 4, 1958, under the Patronage of H.R.H. the Duke of Edinburgh. Immediately preceding this event, an associated scientific symposium organized by the National Physical Laboratory, Teddington, Middlesex, Nov. 24-27, 1958.

(Continued on page 205)

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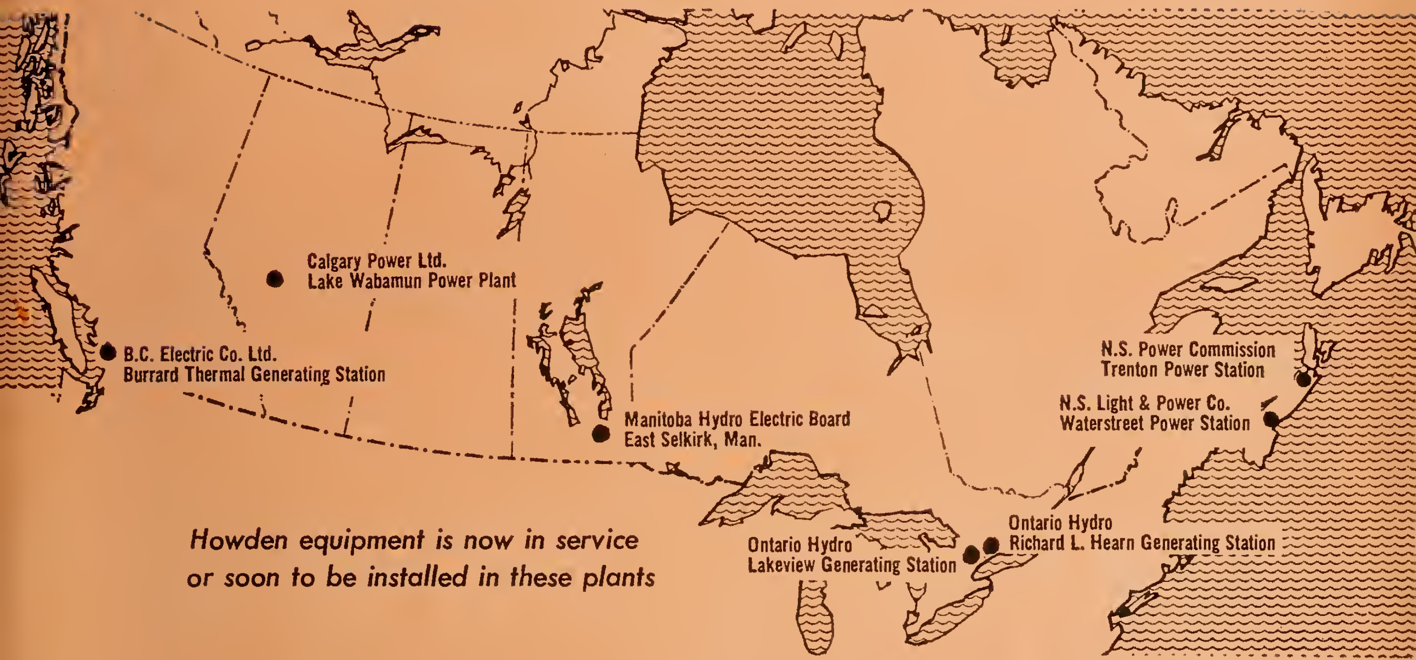

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BOOK NOTES

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*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

ELECTRIC CRANES, 3RD ED.

This edition has been completely re-written to include all the progress made in mechanical handling and electric cranes since the last edition was published in 1922. Its publication will be warmly welcomed by all those interested in mechanical handling and the design, construction and application of electric cranes.

New subjects covered include photo elastic methods of stress analysis; the use of recording strain gauges; the use of influence lines in determining the effect of moving loads, etc.

Included in this complete survey are chapters dealing with crane types; framed structures; compression members; ropes; gears and gearing; transmissions; motor characteristics and control; standardization; cargo handling, etc. There are useful bibliographies at the end of each chapter. (H. H. Broughton. London, Spon, Toronto, Van Nostrand, 1958. 511p., $21.00.)

*THE FUTURE SUPPLY OF OIL AND GAS

In place of the traditional forecast techniques such as the proved reserve concept, the author utilizes economic, technological, and geological variables to determine the future availability of oil and gas in the United States and the adjacent continental shelf through the period ending 1975. (B. C. Netschert. Baltimore, Johns Hopkins Press, Toronto, Burns and MacEachern, 1958. 134p., $4.00.)

SOLAR ENERGY

An elementary treatment of the subject commencing with a discussion of the nature of solar energy. The uses of solar energy described include water heaters, heat pumps, space heating, controlled photosynthesis, furnaces and steam boilers, cookers and water distillers, electric generators. A final chapter discusses power which might be obtained from the wind and the sea. (F. M. Branley. Toronto, Ambassador, 1957. 117p., $3.50.)

*ANALYTICAL MECHANICS FOR ENGINEERS, 5TH ED.

A standard text on the subject, covering statics, kinematics, kinetics, and various special topics. This edition includes new material on vector analysis; the equilibrium of bodies, making use of the concepts of virtual work; the equilibrium of force systems, utilizing a general coplanar force system; and the use of the inertia-force method in kinetics (F. B. Seely and others. New York, Wiley, 1958. 475p., $7.25.)

FUNDAMENTALS OF HYDRO— AND AEROMECHANICS

A reprint of an Engineering Societies Monograph first published in 1934, this standard work covers the statics and kinematics of liquids and gases, and the dynamics of non-viscous fluids. It is based on a series of lectures given by Professor L. Prandtl. (O. G. Tietjens. Toronto, McClelland and Stewart, 1957. 270p., $2.05.)

TABLES FOR THE DESIGN OF FACTORIAL EXPERIMENTS

Published in Japan, with a new title page inserted by the United States publisher, Dover publications, this book contains tables for designing factorial experiments and covers Latin squares and cubes, factorial design, fractional replication in factorial design, factorial designs with split-plot confounding, factorial designs confounded in quasi-Latin squares, lattice designs, balanced incomplete block designs, and Youden's squares. The authors have used the standard notation system, and where they have introduced their own symbols, an explanation has been added. The authors are well known in the fields of mathematics and statistics. (Tosio Kitagawa and Michiwo Mitome. Toronto, McClelland and Stewart, c.1953. irreg. paging, $8.80.)

*MATHEMATICAL FOUNDATIONS OF INFORMATION THEORY

Two papers translated from Russian. The first develops the concept of entropy in probability theory as a measure of the uncertainty of a finite "scheme", and discusses a simple application to coding theory. The second gives a complete detailed proof of both Shannon theorems, assuming any ergodic source and any stationary channel with a finite memory. (A. I. Khinchin. New York, Dover, Toronto, McClelland and Stewart, 1957. 120p., $1.35.)

THE CONDUCT OF MEETINGS

The Secretary of the Toronto Board of Trade has compiled a handy guide to correct procedure at meetings, which will be of benefit both to chairmen and others attending meetings.

The first part discusses the different functions of a business meeting: preparation for it; opening the meeting and order of business; resolutions; minutes; committees, etc. The second part illustrates with examples the points covered in the first part. (G. H. Stanford. Toronto, Oxford, 1958. 88p., $2.50.)

*GAS TURBINE MATERIALS

Intended to bridge the gap between the metallurgical textbooks and those on gas turbine design, this volume provides a

THE ENGINEERING INSTITUTE LIBRARY

The publications mentioned in these Notes are now available in the Library. Members of the Institute may borrow books, periodicals, pamphlets, etc. from the Library. The loan period is two weeks, excluding time in transit, and two items may be borrowed at one time. Library hours are: Monday to Friday: 9 a.m. — 5 p.m.; Saturday: 9 a.m. — 12 noon.

Because of a recent change in policy, publications (except periodicals published by other engineering societies) may no longer be purchased through the Library. If members have difficulty obtaining material locally, it is suggested they write to the Library, and the enquiry will be forwarded to an appropriate bookseller. For further information write to the Librarian.

survey of high-temperature materials chiefly in the field of metallic alloys. Their development is outlined, the behaviour of metals under stress and temperature is discussed, followed by the application of high temperature materials. The influence of fuel and of performance requirements on operating conditions is dealt with, and the final chapter takes up the manufacture of gas turbine components. (G. Lucas and J. F. Pollock. London, Temple Press, 1957. 163p., 25s.)

*MOTION AND TIME STUDY

Presents the fundamentals of methods, time study, and wage payment with a view to providing substantial savings in labor and materials. In addition to proven techniques of work measurement, the author outlines the controls made possible once fair time standards have been developed. This edition gives increased emphasis to work sampling, indirect labor standards, curve plotting, and maintenance of standards. (B. W. Niebel. Homewood, Ill., Richard D. Irwin, 1958. 494p., $8.70.)

NUCLEAR ENGINEERING MONOGRAPHS
1. ELEMENTARY NUCLEAR PHYSICS
2. NUCLEAR REACTOR THEORY
3. REACTOR HEAT TRANSFER

A new series of booklets on nuclear engineering, written in England, and intended for university students, and those working in the field.

The first monograph explains for non-physicists the basic nuclear physics of reactors, and discusses in an elementary manner nuclear theory, radioactivity, nuclear reactions, fission, and radiation measurements.

The physics of reactor design are outlined in the second monograph which commences with an account of neutron behaviour in reactors. It is shown how theories of slowing down and diffusion of neutrons can be applied to determine the behaviour of neutrons in a reactor lattice. Also discussed are the changes in reactor properties due to temperature and neutron irradiation, and the various reactor types and the ways in which they can be fuelled.

The third monograph deals with the important subject of heat transfer from the fuel elements to the coolant. The topics covered are: the fundamentals of convective heat transfer; the application of heat-transfer principles to reactor design; various aspects of reactor heat transfer.

All the monographs are written by specialists in the field. The three volumes still to be published will cover nuclear reactor shielding, nuclear reactor control and instrumentation and steam cycles for nuclear power plants. (General ed. W. K. Mansfield. New York, Simmons-Boardman, 1958. v.1, v.3, $2.75 ea., v.2, $2.95.)

*ZONE MELTING

Covers the theory and practice of zone melting. Included is a description of how to build and operate zone refiners; a complete set of computed zone refining curves showing impurity concentrations throughout an ingot as a function of the number of passes; a discussion of continuous multistage techniques; and information on solidification methods for growing and controlling properties of semi-conducting crystals. (W. G. Pfann. New York, Wiley, 1958. 236p., $7.50.)

THE ROLLING OF METALS, V. 1

Adapted from a series of articles which appeared in the periodical Sheet Metal Industries, this work is concerned solely with the rolling of flat products. It covers such topics as forward slip, flow of material, yield stress, friction, factors influencing rolling load, theories of rolling applicable to thin sheet and strip, and the calculation of the rolling load. There is a classified bibliography of over twenty pages. (L. R. Underwood. London, Chapman and Hall, Toronto, Ryerson, 1950. 344p., $9.00.)

CONDUCTANCE CURVE DESIGN MANUAL

This manual explains the use of conductance curves in circuit designing, and is based on a technique originated by the author for designing electronic circuits. The first of the three main sections of the book gives a brief explanation of the special curves and their application in typical R-C amplifier designs. The second section contains tables useful in making tube substitutions, and in selecting tubes for given applications. The last section gives a special set of curves arranged to make tube circuit design easier. (K. A. Pullen. New York, Rider, 1958. 114p., $4.25.)

PHYSICS AND MATHEMATICS IN ELECTRICAL COMMUNICATION

Intended for all those interested in physics, mathematics and electrical engineering, and their inter-relation, this is a clearly written book, illustrated with many graphs. It covers conic section curves, circles, ellipses, parabolas, and hyperbolas; exponentials; alternating current; and electrical oscillations.

The book is an explicit explanation of what happens in electrical circuits containing resistance, inductance and capacitance. (J. O. Perrine. New York, Rider, 1958. 261p., $7.50.)

LINEAR PROGRAMMING AND ECONOMIC ANALYSIS

The aim of this study is to show the relationship of linear programming to standard economic analysis. It is intended primarily for economists needing a broad introduction to the theory of linear programming, and for those interested in managerial economics.

Some of the topics covered include: basic concepts; the valuation problem; linear-programming analysis of the firm; nonlinear-programming; the statistical Leontief system; elements of game

● LIBRARY NOTES

theory; interrelations between linear programming and game theory. There is a useful bibliography. (R. Dorfman and others. Toronto, McGraw-Hill, 1958. 525p., $11.50.)

*ASME HANDBOOK: METALS ENGINEERING — PROCESSES

Gives information on the various processes by which metals are converted into the finished product. Among the manufacturing methods included are the heat treatment of steel, casting, hot working, cold working, powder metallurgy, welding and cutting, machining, finishing, and electroforming. For each method the basic physical characteristics to be considered are given along with its advantages and disadvantages. Also presented are data on the suitability of various metals for each process and the tolerances on size and surface finish obtainable. One of a series of four volumes sponsored by the American Society of Mechanical Engineers. (Ed. by R. W. Bolz. Toronto, McGraw-Hill, 1958. 428p., $16.20.)

*NONLINEAR CONTROL SYSTEMS

Treats the nonlinear phenomena arising in the area of control systems. Topics discussed include the rise of techniques for linear systems with time varying parameters for determining the response of control systems; nonlinear systems excited by random input signals; reduction of statistical problems to differential equation form; and application of switching circuits in control systems. The approach to the subject is expedited by the use of the concepts and terminology of automatic-control theory rather than those of classical mechanics. (R. L. Cosgriff, Toronto, McGraw-Hill, 1958. 328p., $10.80.)

METAL INDUSTRY HANDBOOK AND DIRECTORY, 1958

The first section of this useful handbook contains a wealth of information on the properties of metals and alloys, the second section consists of general data and tables, including temperatures required for various purposes, hardness tables, tables of gauges, prices of metals over the last 28 years, etc. The third section contains information on electroplating and allied processes, while the last section, in which the pages are green, is a directory. In addition to a buyers' guide, this section contains a list of trade names, and information on British metal and allied trades associations and societies.

This is a British publication appearing annually. (London, Iliffe, Toronto, British Book Service, 1958. 544p., $3.50.)

SPINNING TOPS AND GYROSCOPIC MOTION

In this reprint of a work first published some 50 years ago under the title of Spinning Tops, the author explains on an elementary level the importance of studying the behaviour of spinning tops

and gyroscopes. Some of the topics covered include quasi-rigidy in flexible and fluid bodies, and its nature; the reasons for the fall of a gyrostat and the rise of a top; the effect of climatic conditions on the earth's precessional movement; the effect of internal fluidity on rotating bodies. (John Perry. Toronto, McClelland and Stewart, 1957. 102p., $1.10.)

*BIBLIOGRAPHIC SURVEY OF CORROSION, 1954-1955

A thorough review of corrosion literature for the period covered. Substantial abstracts of papers cited are arranged in eight major divisions: general, testing, characteristic corrosion phenomena, corrosive environments, preventive measures, materials of construction, equipment, and industries. Author and subject indexes are included. (Houston, National Association of Corrosion Engineers, 1958. 468p., $20.00.)

*CONCRETE TECHNOLOGY, VOL. 1: PROPERTIES OF MATERIALS

This volume deals with the following aspects: kinds of cement and their properties; additives; concrete aggregates; lightweight concrete; concrete mix design and quality control; properties of cements and concrete; deterioration of concrete and its resistance to chemical attack. There are bibliographies at the end of each chapter. (D. F. Orchard. London, Contractor's Record, 1958. 348p., 45/-.)

SAFETY TECHNIQUES FOR RADIOACTIVE TRACERS

The widespread use of radioactive material in laboratories, even in the very small quantities required in tracer investigations, means that adequate precautions must be taken to safeguard health. This little book explains the various types of radiation which may be encountered in the laboratory, the safety techniques to be adopted in working with radioactive material, the disposal of radioactive waste, laboratory administration and recommendations for safe working. The appendices include a table of isotopes showing their toxicity, diagrams of protective equipment, maximum permissible quantity of radiation, etc. (J. C. Boursnell. Toronto, Macmillan, 1958. 68p., $1.30.)

D-C CIRCUIT ANALYSIS

One of the most fundamental aspects of electricity is covered in this book which stresses the basic concepts: charge, electric current and potential difference, resistance and conductance, resistance factors, resistivity, conductivity, simple and combination d-c circuits, Kirchhoff's laws and Thévenin's theorem. (Alexander Schure. N.Y., Rider, 1958. 72p., $1.35.)

NUCLEAR ENERGY

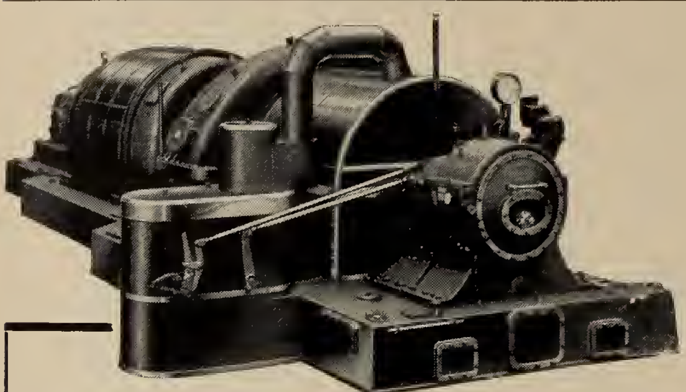
Another in Rider's Basic Science Series, this volume explains the structure and uses of the atom. The first chapter discusses the electron, the proton, alpha, beta and gamma rays, the Bohr atom model, the structure of the nucleus, and isotopes. The second chapter discusses the sources and applications of nuclear energy, and the tools of the nuclear physicist. The last chapter discusses more advanced theories of atomic structure based on quantum considerations and wave mechanics. (Alexander Efron. New York, Rider, 1958. 63p., $1.25.)

MECHANICS

The author has commenced this basic text with a discussion of vectors which is used as a base for later discussion of moments, torques and kinematics. Succeeding chapters cover dynamics, work, energy and power. (Alexander Efron. N.Y., Rider, 1958. 112p., $1.50.)

*SWITCHING CIRCUITS AND LOGICAL DESIGN

Presents the fundamentals and applications of switching theory. Among the various aspects discussed are switching algebra; switching components and their characteristics, including relays and high speed components; contact networks; gate circuits; and switching aspects of codes. Although the book does not deal specifically with computing machines, the switching theory discussed is funda-



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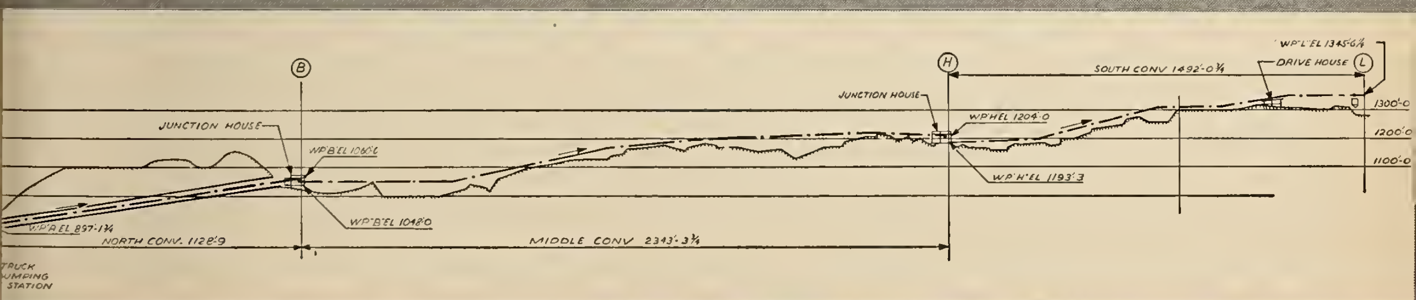


DOMINION RUBBER

Dominion Rubber

Mechanical Goods Division

mental to their design. (S. H. Caldwell. New York, Wiley, 1958. 686p., $14.00.)

ELEMENTARY PARTICLE ACCELERATORS

A Supplement to the Soviet Journal of Atomic Energy now published in English translation, this volume contains previously unpublished reports.

"The reports published in this collection should be useful for specialists working with cyclic or linear elementary-particle accelerators—". Ed. (New York, Consultants Bureau, 1958. 66p., $15.00.)

NUCLEAR REACTORS IN LIGHT NUCLEI

Another Supplement to the Soviet Journal of Atomic Energy translated into English, containing ten reports of work carried out in the USSR in 1951-1955 on nuclear reactors. (New York, Consultants Bureau, 1958. 73p., $15.00.)

AN INTRODUCTION TO FOURIER ANALYSIS AND GENERALISED FUNCTIONS

Based on an undergraduate course, this volume covers the principal results concerning Fourier transforms and Fourier series, and serves as an introduction to the theory of generalized functions. Detailed mathematical knowledge is not required for an understanding of the book, although a general knowledge of mathematical proof is assumed in the reader. (M. J. Lighthill. Toronto, Macmillan, 1958. 79p., $3.00.)

*APPLIED MATHEMATICS FOR ENGINEERS AND PHYSICISTS, 2ND ED.

Covers a wide range of topics in advanced fields of calculus. The chapters on matrix algebra, Fourier methods, variational methods, Laplace transforms, and nonlinear differential equations have been considerably expanded in this edition. A new section on Cartesian tensors has been added to the chapter on vector analysis. New illustrations have been added, and the number of problems doubled. (L. A. Pipes. Toronto, McGraw-Hill, 1958. 723p., $10.50.)

*THEORY OF STRUCTURAL ANALYSIS AND DESIGN

Aspects of structural analysis included are lateral and out-of-plane loading, curved girders, and space frames. Secondary stresses and participation stresses, including the effect of gussets are discussed, and extensive curves are given for stiffness and carry-over factors. A particular feature is the extensive treatment of arches, including continuous arches and arches with stiff ties, with extensive influence lines and tables for both vertical and horizontal loading. (J. Michalos. New York, Ronald, 1958. 552p., $12.00.)

*HEAT TRANSFER AND FLUID MECHANICS INSTITUTE, 1958. PREPRINTS OF PAPERS

Papers covering such areas as aerothermodynamics, fluid dynamics, dynamics of reactive fluids, heat transfer, magnetohydrodynamics, and hypersonics. The total of twenty-one papers provides an up-to-date review of advances in important sectors of the field. (Stanford, University Press, 1958. 264p., $8.50.)

*THE GYROSCOPE

A study of the mathematical and mechanical aspects of the gyroscope. Following a discussion of the theory, specific applications are discussed, including vehicles and rotating bodies, direction indicating and steering, stabilizing, and astronomy. Vector methods are used throughout in the solution of problems. (J. B. Scarborough. New York, Interscience, 1958. 257 p., $6.50.)

*ENGINEERING ECONOMY, 3RD ED.

Deals with the various stages of planning from the inception of an idea to its development and design phases, including the design and operation of a factory to produce the product. This edition brings cost data up to date and introduces new operations research procedures, particularly the concept of "models" and "criteria". The effect of state and federal taxes on engineering projects is treated for the first time. (C. E. Bullinger. Toronto, McGraw-Hill, 1958. 379p., $8.40.)

*ANNUAL REPORT ON THE PROGRESS OF RUBBER TECHNOLOGY, VOL. 21, 1957

A series of papers surveying developments within the field of rubber technology, including compounding ingredients, fibers and fabrics, tires, belting, hose and tubing, cable and electrical insulation, footwear, surgical goods, cellular and hard rubber, flooring, machinery and appliances, and roads. (Ed. by T. J. Drakeley. Cambridge, W. Heffer and Sons Ltd., for the Institution of the Rubber Industry, 1957. 134p., 25/-.)

*FINITE QUEUING TABLES

Provides tables useful in the solution of queuing problems such as communication channel requirements for finite populations, machine loading determinations, and estimating equipment and manpower requirements. A preface gives information and examples illustrating the use of the tables in specific applications. The second volume in the series "Publications in Operations Research" sponsored by the Operations Research Society of America. (L. G. Peck and R. N. Hazelwood. New York, Wiley, 1958. 210p., $8.50.)

*RIGID FRAME FORMULAS

Covers all single-span types of rigid frames. The formulas for the bending moments and reactions on rigid frames of a number of different types, and many loading conditions can be used to secure results rapidly by the direct substitution of numerical values. The Mohr equation, aided by the diagrams in the book, provides a rapid method for computing displacements of rigid frame structures. Eleven new frame shapes are dealt with in this edition. (A. Kleinlogel. New York, Ungar, 1958. 460p., $14.50.)

*RECENT ADVANCES IN THE ENGINEERING SCIENCES: THEIR IMPACT ON ENGINEERING EDUCATION

Surveys the educational implications of a number of expanding areas including automation and automatic control; operations research and systems engineering; thermodynamics; mass, momentum and heat transfer; nuclear engineering; solid

state physics and engineering materials, computer development and applications. The book is a report of the proceedings of the Conference on Science and Technology for Deans of Engineering, held at Purdue University in September 1957. (Toronto, McGraw-Hill, 1958. 257p., $5.70.)

*ELECTRICAL ENGINEERING PRACTICE, VOL. 1, 6TH ED.

A review of current British practice to appear in three volumes. The first part of volume I deals with definitions, materials, and measurements, the second part with the generation and sale of electrical energy, and the third part with the transmission and control of electricity, including switchgear and protection of circuits. (J. W. Meares and R. E. Neale. Toronto, Ryerson, 1958. 716p., $12.00.)

*CIRCUIT ANALYSIS OF TRANSMISSION LINES

An analytical approach to transmission lines with special attention given to radio frequencies and measurements. Simple transients, including application of transient operational methods, are discussed, as are matching devices and the design of resonators and transmission cavities. Also discussed are the standing wave ratio and the principles and applications of the Smith chart. (J. L. Stewart. New York, Wiley, 1958. 186p., $5.50.)

*PRINCIPLES OF NOISE

Covers such areas as probability, stationary random processes, physical sources of noise, equivalent noise generators, noise factor, measurement of a direct voltage, Gaussian random processes, the detection of alternating waveforms, and target noise. (J. J. Freeman. New York, Wiley, 1958. 299p., $9.25.)

*THE EFFECTS OF RADIATION ON MATERIALS

Theories and concepts of radiation effects, radiation sources, and measurements of radiation are presented, as are the known effects of radiation on the physical, metallurgical, mechanical, corrosion and electrical properties of materials. Among the materials dealt with are metals, alloys, inorganic dielectrics, semiconductors, organic and polymeric materials, and materials for nuclear reactor components. Comprises papers delivered at the Colloquium on the Effects of Radiation on Materials at Johns Hopkins University in 1957. (Edited by J. J. Harwood and others. New York, Reinhold, 1958. 355p., $10.50.)

*PERFORMANCE OF METAL CUTTING TOOLS

The author has gathered together information on the mechanical and physical performance of metal-cutting tools. Aspects discussed include the theory of continuous type chip formation, tool life, and surface finish. There is a bibliography of

158 references. (R. Tourret. Toronto, Butterworth, 1958. 184p., $10.00.)

*AUTOMATIC PROCESS CONTROL

Automatic control principles are presented with emphasis on block diagrams and frequency techniques in process control. Beginning with process and controller characteristics, the book continues with the closed loop in automatic control, measuring and controlling elements, process instrumentation, sinusoidal analysis, and stability analysis. (D. P. Eckman. New York, Wiley, 1958. 368p., $9.00.)

*AUTOMATIC CONTROL: PRINCIPLES AND PRACTICE

The first part of the book is concerned with the dynamic behavior of control systems, including static requirements and adjustments for peak performance. This is followed by a detailed description of electrical and mechanical components such as measuring elements, controllers, and control valves. Various control systems and their specific applications are then described. The approach is in terms of practical concepts rather than in mathematical terms. (W. G. Holzbock. New York, Reinhold, 1958. 258p., $7.50.)

*AIRCRAFT AND MISSILE PROPULSION. VOL. 1: THERMODYNAMICS OF FLUID FLOW AND APPLICATION TO PROPULSION ENGINES

This volume, the first in a three volume work, covers the following areas: fundamental principles of thermodynamics; general characteristics of propulsion systems; thermodynamics of compressible fluid flow; flow through nozzles; flow through diffusers. A large number of illustrative problems are completely worked out. (M. J. Zucrow. New York, Wiley, 1958. 538p., $11.50.)

*A COMPREHENSIVE BIBLIOGRAPHY ON OPERATIONS RESEARCH

A listing of 3000 books, articles, reports and proceedings intended for operations researchers. Material closely related to this field is included. An alphabetical index to all of the citations is followed by bibliographies dealing with special fields of interest such as sequencing, theory, site location, layout, etc. The main bibliography covers references through 1956; a supplement contains titles published in 1957. (By the Operations Research Group, Case Institute of Technology. New York, Wiley, 1958. 188p., $6.50.)

*MATERIALS AND METHODS OF ARCHITECTURAL CONSTRUCTION, 3RD. ED.

A completely rewritten edition of a standard work. Modern design formulas and current working unit stresses are presented and explained. Among the many new areas discussed are tilt-up, lift-slab, lamella, and stressed skin construction; air-entraining cement; modular coordination; aluminum alloys and monel metal; tempered plate glass and plexiglass; flat-plate design; and the slab-band system. (H. Parker and others. New York, Wiley, 1958. 724p., $12.00.)

Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

Champlain Oil Company — J. C. Clapinson has been elected president of Champlain Oil Products, Limited. He succeeds R. L. Dunsmore, M.E.I.C., who is retiring as president, but will continue to be a director of the organization.

B. F. Goodrich—I. G. Needles has recently been elected chairman of the board of B. F. Goodrich Canada Ltd., Kitchener, Ont.; also elected was R. V. Yohe as president and chief executive of the company.

Controllers Institute—N. J. Brown, comptroller, The Steel Company of Canada Ltd., has been elected president of the Hamilton Control of the Controllers Institute of America. J. G. Sheppard, secretary and comptroller, Dominion Foundries & Steel Ltd., is the new treasurer of the group, and J. A. Durfey, treasurer, Bridge & Tank Co. of Canada, Limited, has been selected a director.

Mannix Co. Ltd.—The following executive appointments were announced recently by Mannix Co. Ltd.: T. C. Oxman, vice-president and manager of operations; E. P. Lougheed, vice-president of administration and a director, continuing as general counsel; C. P. Baker, manager of the general contracts division.

R. V. Yohe

George Kent (Canada) Ltd.—P. Hooper has been appointed sales manager for George Kent (Canada) Ltd., Toronto, and B. Kipling is now projects manager, in charge of planning and development. Also announced is the appointment of two additional sales representatives: M. Stretton, covering the Toronto and Hamilton area, and D. Tizard, who will be responsible for the London, Windsor, Sarnia district.

Northern Ontario Natural Gas Co. — Announcement has been made of the appointment of K. J. Edleman as residential and commercial sales manager of Northern Ontario Natural Gas Company Limited, Toronto.

R. H. Nichols — It has been announced by R. H. Nichols Limited that A. W. Bleue, formerly sales manager, has been appointed to represent the company in the West; he will be located at 624 Vancouver Block, 736 Granville St., Vancouver 2, B.C.

Sun Oil Company — R. D. McCleary and C. E. Scott have been appointed industrial products department representatives for Sun Oil Company Ltd., Toronto; they will be active in the Ontario sales territories. Also announced is the appointment of G. L. Harrison as industrial products department representative; his sales territory will include Quebec and Eastern Ontario.

Leland Electric — D. W. Richardson has been made assistant general sales manager of Leland Electric Canada Limited, Guelph, Ont.

Linde Air Products — The appointment of R. H. Rastorp as assistant manager, advertising and sales promotion department, Linde Air Products Company, division of Union Carbide Canada Limited, has been announced recently. Mr. Rastorp will be responsible for the overall operation of the department.

W. M. de Carteret

Franki Fellowship Award — Franki of Canada Limited have announced the award of the Franki Fellowship Award to Michael A. Hargraft, B.A.Sc., University of Toronto. The Franki Fellowship is awarded every second year to a student graduate in science, engineering or agriculture who has made a special study in soil mechanics.

Dominion Engineering — P. D. Mosher has been appointed sales engineer for the paper machinery division of Dominion Engineering Works Limited. He will assist J. B. Stirling, JR.E.I.C., sales engineer, in serving all the paper mills in eastern Canada including the Quebec City area.

Neptune Meters — Neptune Meters Limited have announced the appointment of W. M. de Carteret as branch manager of their Calgary office.

Imperial Oil—V. Taylor, formerly man-

• BRIEFS

ager of Imperial Oil Limited's producing operations in western Canada, has been appointed a director of the company.

Bechtel Corporation — W. K. Davis has been elected a vice-president of Bechtel Corporation, responsible for advanced engineering projects in the nuclear field.

Quebec Iron and Titanium — The appointment of J. M. Herndon as assistant general manager of Quebec Iron and Titanium Corporation has recently been announced.

New Vice-President — Announcement has been made of the appointment of R. A. Wykes as vice-president and managing director of the Taylor Woodrow Group (Canada), replacing R. Hirst.

Canadian Line Materials — J. W. MacLea, formerly manager of sales promotion of Canadian Line Materials Limited, Toronto, has recently been appointed sales manager for the company.

Saguenay Electric Company — The following executive appointments have recently been announced by the Saguenay Electric Company: P. Tellier has been appointed executive vice-president; G. Dufour, M.E.I.C.,, has been named vice-president and general manager; P. Beaulieu, treasurer, and G. Proulx, M.E.I.C., have been made vice-presidents of the organization.

News of Business and Industry

Continuation of Consulting Practice — Mr. H. H. L. Pratley, M.E.I.C., has announced that he will continue to carry on in Montreal, in his own name, the practice of his late father Dr. P. L. Pratley, M.E.I.C., who was so well-known as a member of the Institute and to Canadian engineers generally.

Plant Extension — Peacock Brothers Limited are undertaking an extension of one of their plants in order to consolidate and expand their valve manufacturing facilities. The plant is located at 161 Stirling Avenue, LaSalle, Que., and the extension, when completed next summer, will be five times the size of the existing plant.

New Location — Ontario General Contractors Association have recently announced their new location at 57 Bloor Street West, Toronto, Ont. Tel. No.: WAlnut 1-0122.

Arctic Aerial Survey — Two high-altitude long-range photographic B-17's are being serviced and overhauled for The Photographic Survey Corporation at Oshawa Airport near Toronto. They are to play a key role in the Canadian government's $6.3 million Arctic Islands aerial survey. This survey starts this spring and is expected to take four to six summer seasons to complete. The B-17's have been fitted by Field Aviation Company Limited, a PSC associate, with special equipment including long-range tanks to enable them to remain airborne over the Arctic upwards of 15 hours.

Safety Award—The Canadian Kellogg Company, Ltd. has recently been awarded the B.C. Centennial Safety Award Certificate, commending the company for completing 16,573 man-days free of accident in one month during the construction of the British American Oil Company's new Port Moody refinery. Kellogg's safety record was achieved during the peak period of construction. The vast amount of work accomplished during this time has helped speed the job to the point where it is several weeks ahead of contract schedule. Construction will be completed early this fall, almost exactly one year from the date when initial foundation work was begun.

Bathurst Acquisition — Bathurst Power & Paper Company Limited has announced that its subsidiary Bathurst Containers Limited has entered the western Canadian market through the acquisition of the assets and undertakings of Norwood Box Co. Ltd., St. Boniface, Manitoba. Norwood Box Co. Ltd. has been engaged in the manufacture and sales of corrugated and solid fibre shipping containers. The purchase of Norwood assets represents a significant addition to the converting facilities of Bathurst Containers Limited already operating in five plants strategically located throughout Ontario and Quebec.

Union Carbide New Division — Announcement of the formation of a new division of Union Carbide Canada Limited was made recently. The new division, known as Haynes Alloys Company, will handle all sales in Canada of Haynes Stellite Company, Division of Union Carbide Corporation. The products marketed by the new division will include more than 100 different special alloys, castings, and fabricated products. Consideration will be given to the installation of production facilities in Canada when the market warrants. Office and warehouse location of Haynes Alloys Company, Division of Union Carbide Canada Limited, is at 805 Davenport Road, Toronto.

Ames Canadian Office—Announcement has been made by The B. C. Ames Company, of Waltham, Mass., of the opening of a Canadian office at 45 Oriole Parkway, Toronto 7. A representative stock of the complete range of Ames micrometer dial gauges and dial indicators, and replacement parts will be carried, and complete engineering and servicing facilities available. The sales and service staff will be under the management of J. A. Morrison.

• BRIEFS

Canadian Agent—Frommelt Industries of Dubuque, Iowa, makers of the Car-Dox snug fit dock covers have appointed Horsfall Engineering, 2696 St. Clair Ave. West, Toronto, as their sole Canadian agent.

Loading Dock—An unusual loading dock, located a quarter of a mile from shore, will be built at Ogden Point, Ont. The St. Lawrence Cement Company, of Clarkson, Ont., has awarded a contract to Dravo of Canada Limited, Toronto, for construction of the 480-foot-long cellular steel sheet pile dock. Included in the contract also are a quarry stone causeway and a 700-foot-long trestle to carry a belt conveying system. The dock, one of the few of its type on Lake Ontario, will be used for loading quarried limestone on ships bound from Ogden Point, near Colborne, about 100 miles east of Toronto, to St. Lawrence Cement's Clarkson plant. Locating the dock 1300 feet from shore in water 32 feet deep eliminates the necessity for dredging a harbour to accommodate the draft of lake freighters. Officials of St. Lawrence Cement expect to use the dock 12 months a year. They intend to start shipping early in the summer of 1959.

Canadian Valves Representatives—Announcement has been made of the appointment of the J. B. Morrison Machinery Co. Ltd., 45 Oriole Parkway, Toronto 7, as exclusive Canadian representatives for Valcor Engineering Corp., Kenilworth, N.J. Morrison will stock and service the complete range of industrial solenoid valves manufactured by Valcor, and complete engineering services will be available.

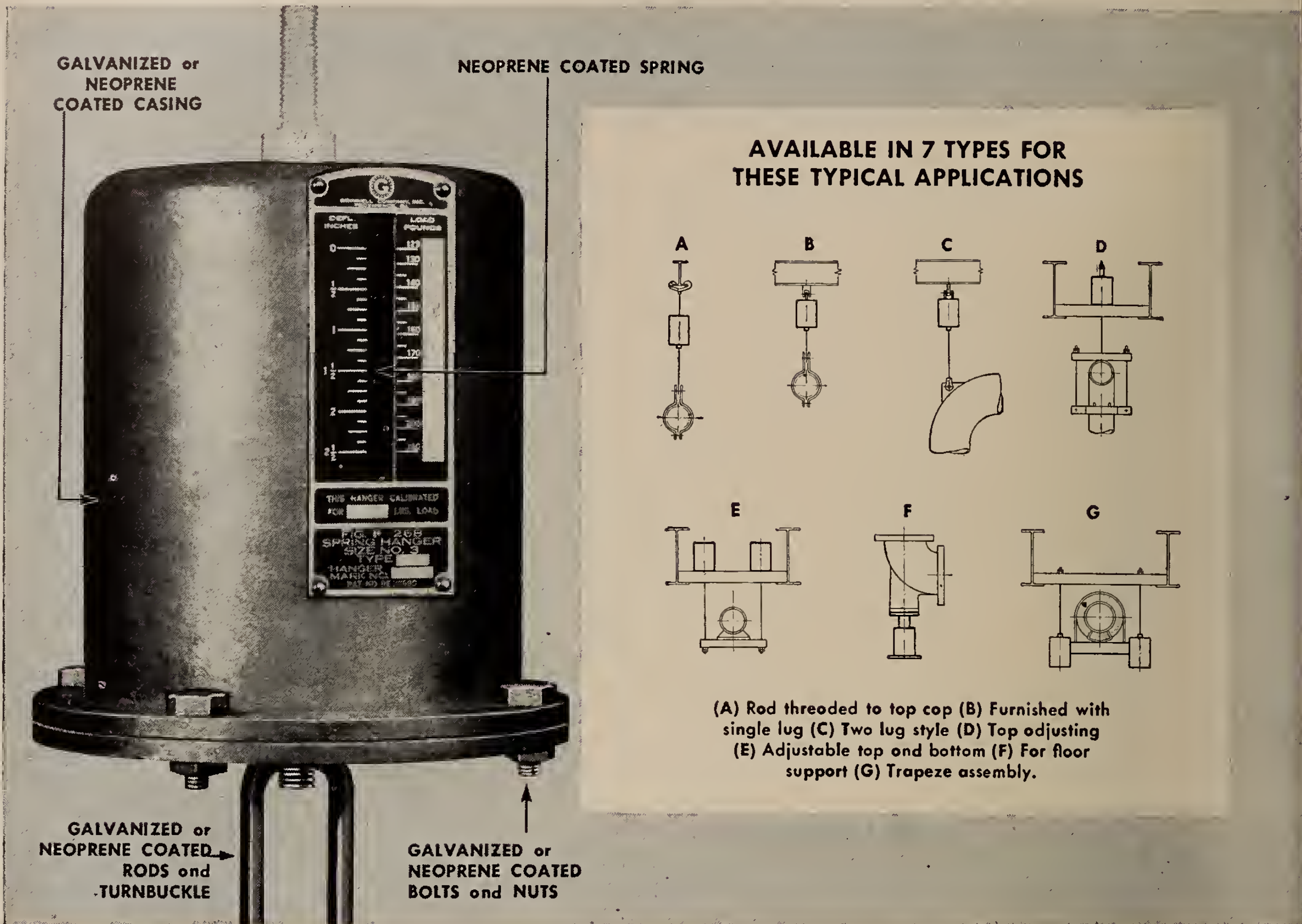
Westinghouse Contract—The Canadian Westinghouse Company has been awarded a contract by the Quebec Hydro-Electric Commission for four 76,800 h.p. generators for the third section of the Beauharnois power development now under construction near Montreal. The four generating units and six identical machines already on order will practically complete the new generating station. Beauharnois Three will be interconnected with Hydro-Quebec's overall system and the new power will serve the Metropolitan District of Montreal. The first power-producing generator is expected to go into service early next year.

Dental Building—Being built by The Foundation Company of Ontario Limited, the new $6,000,000 dental building for the University of Toronto will be one of the most modern dental teaching units in the world. It also represents the first major academic construction project to be undertaken in the University's expansion plans, estimated to cost $50,000,000.

Canadian Plant — Cleaver-Brooks Company, Milwaukee, Wisconsin, manufacturers of packaged boilers for industrial, institutional and commercial applications, plans to build a new plant in Stratford,

corrosion-resistant, weather-resistant

GRINNELL VARIABLE SPRING HANGERS



In addition to their proven corrosion and weather resistance, these spring hangers offer other features.

- Maximum variation in supporting force for standard spring models per ½" of deflection is 10½% of rated capacity — in all sizes.
- Precompression (a patented feature) assures operation of spring within its proper working range, as well as saving valuable erection time. Reduced over-all height saves space.
- 21 sizes available from stock for load ranges from 50 lbs. to 28,200 lbs.
- Available in 3 spring lengths for maximum travel of 1¼, 2½, and 5 inches.
- Installation simplified by integral load scale and travel indicators.
- All-steel welded construction meets pressure piping code.

For hanger installations which are subject to highly corrosive industrial conditions — or where exposed to severe weather, Grinnell makes available two distinct lines of pre-engineered spring hangers.

These hangers are the result of extensive experimentation with various coatings for Grinnell's standard pre-engineered spring hangers. In addition to providing flexibility in pipe suspension, they provide versatility of application through their corrosion-resistant characteristics.

1. NEOPRENE COATED – for highly corrosive conditions, such as those found in chemical plants and refineries. All parts of the hanger are neoprene coated to protect the base metal from a wide range of corrosives. The flex life of the spring is unaffected by the neoprene . . . the coating resists cracking or flaking over a wide temperature range.

2. GALVANIZED – for outdoor installations, where weather conditions are severe. All parts of the hanger are galvanized except the spring, which is neoprene coated to avoid alterations of temper, hydrogen embrittlement and decreased flex-life of the spring – usual hazards to springs from the galvanizing process. Write for further details.

GRINNELL

CANADA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company of Canada Ltd. • Edmonton • Montreal • Toronto • Vancouver • Winnipeg • Distributors in Principal Cities

pipe fittings • welding fittings • pipe hangers • valves • Grinnell-Saunders diaphragm valves • pipe prefabricated piping • heating specialties • water works supplies • Grinnell automatic fire protection systems

• BRIEFS

)nt. The firm plans to spend about 900,000 on its Stratford development. This includes a 25,000 sq. ft. production ind test center slated for occupancy ate this year. Initial production is set or early 1959. This marks the first ime that an American manufacturer of his type equipment has built a Canadian lant.

Canadian Agents—As the result of the ecent tour of Canada by J. G. Gershon, ales director of Rocol, Ltd., Swillington, ear Leeds, England, manufacturers of pecialized molybdenized and other ubricants, the following Rocol agents ave been appointed: British Columbia: nternational Agencies and Machinery Co., Ltd., 2315 Cambie St., Vancouver, 3.C.; all Canada, except British Columbia: W. R. Watkins Co. Ltd., 41 Kipling ve. South, Toronto 18.

New Address—Edgar A. Cross & Associtates, consulting engineers, have announced that their new address is 2510 Yonge treet, Toronto 12, Tel. No.: HUdson -1139.

Exclusive Representative—Abitibi Co., Montreal, are the exclusive representaives for the Tarrant hydraulic slide rule, pecially designed for calculations of flow hrough pipes and circular sewers and in pen channels. The formulæ chosen have een selected from the many exponential ormulæ in general use for such calculaions.

New Affiliate—The Sandwell Organizaion, professional engineering and mangement service, have announced estabishment of a new affiliate, Sandwell Inernational, Inc., with offices in Portland, Dregon. The organization has eight other ffiliates in Canada and abroad. Offices vill be located in the Public Service uilding, Portland. M. R. Oberdorfer, vho has been with Sandwell since 1956, nd formerly was president of St. Helens Pulp and Paper Co., will serve as esident representative.

Construction of $1,000,000 Building — Construction of a new two-storey building by Canadian Kodak Co., Limited at a cost of more than $1,000,000 has been announced. When ready for use in the summer of 1959, the building will house all finishing operations in the production of photographic paper. This new project will complete an extensive five-year, $5,000,000 expansion of Canadian Kodak's photographic paper manufacturing facilities, the company states. It is also part of the company's continuing program of investment in additions, improvements and replacements for plant processes and equipment.

New Pipe Mill — The Steel Company of Canada Limited has started preparations for a new pipe mill on a new site located twenty-five miles east of Montreal at Contrecoeur, P.Q. The new plant will be the initial installation of a 700 acre property acquired by the company during the last year or so. Stelco has estimated the cost to run to some $10,000,000, and it will be the most modern type of continuous butt-weld mill; it is being designed to produce diameters ⅜" to 4" inclusive, in single and double random lengths up to 50 feet.

Contract with Norway — Aluminium Limited, Montreal, recently stated that one of its trading subsidiaries has concluded a new contract in Oslo, Norway, with the largest Norwegian aluminum producer, calling for the delivery during the next 20 years of a total quantity of about 4,400,000 short tons of alumina. It is expected that the major portion of the alumina, which is the principal raw material in refining aluminium, will be supplied by Aluminium Limited's producing company in Jamaica, West Indies.

Change of Location — Canadian General Electric Company Limited has recently announced that the marketing operation of the small appliance department will be located at the small appliance plant at 80 Bradford Street, Barrie, Ont. The Ontario district sales office for the department will remain at 214 King Street West, Toronto.

New Equipment and Developments

New Diesel Engine—A General Motors our-cylinder, two-cycle diesel, rated at 53 h.p. at 2,200 r.p.m. and a high torque f 385 ft. lbs. at 1,600 r.p.m. is one of everal installed in company buses which ave completed 275,000 miles or more vithout any major repair, it was recently tated by General Motors Diesel Limited, London, Ont. Purchased in 1954 with 15 thers, the engine is being stripped down or routine overhaul. General Motors tate that in all probability the engine vould only need rings, pistons and leeves. The crankshaft has been measured and magnafluxed and found to be perfectly straight, without cracks, and journals and throws show no wear or taper. When re-assembled the engine should be good for another 300,000 miles or more.

AC/DC Engine Driven Heliwelder—Air Reduction Canada Limited announces the new 300 amps. AC/DC engine driven Heliwelder for field operation where the welding of structural members of aluminum or magnesium is necessary. In addition, the flip of a switch provides AC or DC straight or reverse polarity welding current with or without high

• BRIEFS

frequency stabilizer. This machine provides 115 volt, 1kw. DC auxiliary power for the operation of electric tools and lights while welding or 115/230 volt, 10kw. single phase 60 cycle power when operated as a power plant only. Complete with automatic inert gas control panel and post flow timer the rated machine output is 65 to 400 amps. AC, 75 to 350 amps. DC and 35 to 375 amps. AC or DC for Heliwelding with maximum OCV of 80 AC - 72 DC.

Dustless Stoper — Canadian Ingersoll-Rand Co. Ltd., Montreal, have announced a new rock drill known as the "Vacujet" dustless stoper which sucks all dust and cuttings down through the drill, then discharges them under pressure through a long hose to a container. The new stoper, described in Ingersoll-Rand's flier Form 4195, works as follows: Vacuum is developed by an ejector jet incorporated into the back-head of the drill. This vacuum draws the cuttings down through the drill steel and the drill. When the dust and cuttings reach the jet, they are caught in the jet air stream and pushed under pressure through a hose to a tank or bag 25 feet or more away from the drill. The manufacturer stresses that the stoper is a completely new drill and not merely a modification.

The Hypsometer Statoscope—Canadian Applied Research Limited, Toronto have announced the design of a height deviation indicator which is said to supply the operator and the pilot with height deviation information with an accuracy of ±5 feet. Known as the "hypsometer statoscope" the design of the new survey instrument is based on the hypsometer circuitry used in C.A.R.L.'s airborne profile recorder, Mk 5.

World's Largest Spray Dryer—In a million-dollar expansion program which will double the waste sulphite liquor capacity at the Quebec plant of Lignosol Chemicals, Ltd., the Canadian company will install the world's largest spray dryer for the production of by-products from waste sulphite liquor. The dryer, which will be engineered and constructed by Bowen Engineering Inc. of North Branch, New Jersey, will be capable of producing 100,000 lb. of spray-dried product daily. A Bowen-patented design allows introduction of cooling air into the drying chamber to cool the product before it leaves the unit.

Photocell Tracer—The "Linde" photocell tracer, a new and versatile photoelectric tracing device designed for attachment to oxy-acetylene shape-cutting machines, has been introduced by Linde Air Products Company, Division of Union Carbide Canada Limited. Sold under the trade mark "L-P-T", this new unit incorporates a recently developed Canadian Westinghouse Company electronic circuit. It automatically traces from a simple pencil or ink line drawing, a great advantage over most existing photoelectric tracing devices which will only follow the edge of a wide line or silhouette. Superceding the older type strip and magnetic drive heads used on shape cutting machines, the "L-P-T" photocell tracer eliminates the necessity of making costly strip or magnetic templates. In many shops, the saving on templates alone could amortize the cost of this new tracer in less than a year.

Screw Type Compressor—The first range of large, two-stage screw type compressors, will be introduced into Canada by Atlas Copco Canada Ltd. The new compressor, which is described as being similar to a roots blower but with a screw twist in its rotors, was developed after ten years of intensive work by the Swedish Rotormachinery Company on an invention patented in 1934 by Professor A. Lysholm. The large capacity machines will be manufactured and sold by Atlas Copco in three models with capacities of 6,700, 10,000 and 19,500 c.f.m free air delivery. The company states that a great deal of the development work on the new compressor centered on investigations of the most suitable rotor profile. The design employed is in the form of circular arcs providing advantages both from mechanical and manufacturing point of view. Because the rotor surfaces are in rolling rather than sliding relationship to each other, they will not damage each other in the event of damage to the timing gears which would lead to a failure to maintain rotor positions.

Open-Type Motor Applications — Canadian Allis-Chalmers Limited, Montreal, have declared that increasing open-type motor application areas at extensive cost reduction are today's improved insulations. Previously, many application required motors with expensive protective enclosures; now, open motors with protection built right into the insulation, are available with the resultant savings of millions of dollars to users. A major factor in this evolution is an all-silicone-rubber insulating system for form-wound stator coils in large motors. Another is epoxy-encapsulated coil structures for field windings of large synchronous motor rotors and for stators of smaller frame motors with random or mush-wound coils. Allis-Chalmers utilizes both in its Super-Seal line of open motors. Silco-Flex silicone-rubber insulation and epoxy resins are the foundation stones of the new line.

Vinyl-Modified Silicone Gums — Two vinyl-modified silicone gums designed for use in the formulation of Class 500 or extreme low temperature service silicone rubber compounds have been added to the standard product line of chemical

Correction

On page 206 of the September 1958 issue, reference was made to equipment manufactured by Ruston & Hornsby Ltd. Inadvertently, the name "Ruston" was misspelled "Rushton".

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materials section, Canadian General Electric Company Limited. SE-54 is the only low shrinkage, extreme low temperature reactive silicone gum now on the market, the company declares. SE-53, is a standard shrinkage polymer. Because these gums are vinyl-modified, ultimate physical properties of the compounds based on them can be obtained with curing cycles shorter than normally required. Other features are the realization of excellent compression set properties without the use of toxic additives, and reduced levels of curing agents.

Publications

Steel Plate for Hydro-Power — Horton Steel Works Limited have recently issued an illustrated brochure on steel plate engineering, fabrication and erection for Hydro Power. Copies of the brochure are available from Horton Steel Works Limited, 25 Adelaide Street West, Toronto.

Iata Airlines—Fifty thousand copies of the first comprehensive collection of the insignia and aircraft liveries of the major scheduled airlines are shortly to be distributed to many parts of the world. Published by the BP Aviation Service, the "BP Book of IATA Airlines" shows the principal aircraft operated, distinctive markings, and the company symbols of 81 airlines which are members of the International Air Transport Association. The booklet gives a brief history of each company in English, German, French and Spanish.

Rod-and-tube Thermostat—Rod-and-tube type steam thermostats for use in commercial appliances are described in a new four-page bulletin published by Robertshaw-Fulton Controls Company, Toronto.

Crane Iron Body Valves—Crane Limited, Montreal, have recently published a pamphlet entitled "Crane Iron Body Valves and their end Connections." The pamphlet provides a quick reference for all personnel responsible for determining valve selection, and contains information on the popular valve sizes and types manufactured by Crane factories.

Lightning Arresters—Northern Electric Company Limited, Montreal, has published a 20-page well-illustrated bulletin dealing with the Slater-Hubbard lightning arresters. The design, construction and application of the various types of autogap arresters are fully described.

Regulator Catalogue—Oxweld industrial gas regulators are described and illustrated in a twenty-page catalogue available free from Linde Air Products Company, Division of Union Carbide Canada Limited, 40 St. Clair Ave. E., Toronto. This comprehensive catalogue includes complete specifications and ordering information on 47 Oxweld regulators available for use with all industrial gases. Inlet and outlet connections are listed according to the American Standards of the Compressed Gas Association.

Comparison of Furnaces—Bulletin GER-1479, published by Canadian General Electric Company compares costs, efficiencies and heat losses of the two types of furnaces used to strand anneal wire continuously. The 8-page publication discusses data collected on the two furnaces over a one month test period in the United States and contains pictures, graphs, curves and formulas.

New Air Starting Motor—Canadian Ingersoll-Rand Company announces a new 20 page bulletin, Form 5094D, describing its complete line of air starting motors for starting Diesel, gasoline and natural gas engines. The new bulletin contains detailed specifications and mounting dimensions on the 34 models in the company's line. Approximately 500 popular engines by 25 engine manufacturers are listed, with the proper air starting motor shown for each engine. In addition, easy to follow instructions are included for selecting the correct air starting motors for unlisted engines.

Watertight Masonry—A 6-page bulletin issued by The Master Builders Co. discusses the important elements involved in the design and specification of watertight masonry. Citing good workmanship and lack of cracks between brick and mortar as the principal pre-requisites to watertight masonry, the bulletin outlines six important considerations to be given in designing watertight masonry walls.

Packaged Air Conditioners—Complete physical data for all units and all major components of new model packaged air conditioners is included in a new, 20-page, illustrated catalogue published by American-Standard Products (Canada) Limited, Canadian Sirocco Products, 310 Ellis Street East, Windsor, Ont. The catalogue, bulletin 6125, superseding 5125, is 8½ in. x 11 in. and describes fully all six models in the line of packaged commercial air conditioning units available through Canadian Sirocco. The six blowers range in size from three to 20-ton capacities.

Aluminum Railings — The Aluminum Company of Canada, Ltd. has issued a 30-page book entitled "Alcan Aluminum Railings for Bridges and Highways." It introduces a complete line of aluminum bridge and highway railing components, including nine railing designs. The book is illustrated with detailed drawings and specifications are included. A copy may be obtained from the Aluminum Company of Canada, Ltd., 1700 Sun Life Building, Montreal, Que.

ENGINEERING NOTES FROM BRITAIN

Computer-Controlled Flame Cutting. The cutting of steel plates by means of an oxygen flame is a process now commonly used in industry. Where plates of rectangular shape are required, this can be done without difficulty on an automatic machine that is set and then left to operate by itself. But where irregular shapes are needed—as is frequently the case in shipbuilding and other industries—it is necessary to make a full-scale template and then cut the plate by hand, which is not always very accurate.

The making of templates and hand control for the profiling of curved edges can now, however, be eliminated by a computer-controlled flame-cutter which has been developed by British Oxygen Gases Ltd., of Cleveland Row, London, S.W.1., in conjunction with Ferranti Ltd., of Chadderton, Lancashire, England.

This machine is designed to follow instructions fed to it from a magnetic tape, and it is claimed that it can cut a plate of any shape under automatic control from start to finish. It has been estimated that this new technique will save as much as 40 per cent of the present cost of profiling plates, as computer-controlled cutting eliminates many of the conventional stages between drawing board and cutting machine.

The machine receives its instructions from the magnetic tape and operation thereafter is entirely automatic as to shape, correction of error and monitoring.

Speeding Welding Time On Big Jobs. Increased production of welded cylindrical vessels with a wide range of sizes is now being obtained at the works, at Barrow-in-Furness, England, of Vickers-Armstrongs (Engineers) Ltd., with the aid of a high-lift boom and traversing roller bed installation. The equipment is being used for the welding of rotary kilns, storage tanks, high pressure and low pressure heaters, rotary coolers, and for other cylindrical fabrications.

The high-lift boom equipment consists basically of a boom of 17 feet six inches in length, one end of which is mounted so that the height of the boom above the roller bed is variable to accommodate vessels of varying diameters. At the other end of the boom is a Fusarc automatic welding head, made by Quasi-Arc Ltd., of Bilston, Staffordshire, England.

Provision is made for the operator and his equipment to be carried at the end of the boom. In the case of internal welds on small diameters, the operator is carried prone. The roller bed can support, turn and traverse a weight of up to 48 tons, and is adjustable to accommodate vessels with diameters ranging from two feet to 15 feet.

Both longitudinal and circumferential welds may be carried out by moving the workpiece while the welding head remains stationary. All motions of the roller bed, as well as all welding conditions, can be controlled by the operator at the welding head. Power is supplied by a 1,000 ampere generator, and continuous covered electrode type is used, at currents up to 750 amp. for internal welding and 900 ampere for external welding.

Automatic Trolley Control System. Applications of electronic control to machine tools, mechanical handling, and automatic weighing devices, have now advanced a stage further with the introduction of a new wire guidance system for the automatic control of powered trolleys and trucks in factories and warehouses.

The method employed is a system of magnetic induction. A wire is laid — or buried — over the desired route and a current passed through the wire sets up a magnetic field which is detected by sensing coils mounted on the front of the trolley.

Stopping and starting from one or more remote control points is provided; several trolleys may be operated independently over the same route with facilities for automatically selecting branch routes, and automatic stopping controls are fitted which operate either if the trolley's path is obstructed or if a failure occurs in the guidance system.

The new system, which has been developed by E.M.I. Electronics Ltd., of Hayes, Middlesex, England, can be used by a variety of undertakings for the mechanical handling of material where previously it has not been economically justifiable.

Automated Production Of Concrete. Continuous 300 feet lengths of pre-stressed concrete beams are now being manufactured in England. The total number of men required to operate the machine is four and they produce one-third of a mile of beam per shift. The process makes moulds superfluous: the concrete is extruded from a travelling machine on to flat beds. When the beam has been cured it is automatically fed to a saw table which cuts off the required lengths. Beams, for floors or roofs or for any other purpose to which pre-stressed concrete can be put, can be cut in lengths up to 30 feet.

The beams are formed on a flat concrete bed over which the casting machine travels suspended from a gantry driven by an electric motor. The moulding section moves in short steps of about 18 inches metering out the correct amount of concrete from an overhead hopper, which is kept supplied from a mixer by monorail truck. The moulding section is moved by compressed air. As the concrete is poured it is vibrated between side plates which, with the concrete bed, act as a forme.

The layout of the casting shop, which has been designed by Richard Lees Ltd., of Mugginton, Derbyshire, England, allows for the travelling moulding gantry to straddle three parallel beds at the same time, one bed casting, one curing and the third being cleared and cut for length. The time cycle is four hours.

Glass Used As Heating Element. Normally, electric heating elements are constructed with resistance wire and their application is confined to the production of heat for use by radiation from a glowing element. A problem arises however when there is a need to spread the heat which has been generated, and a method of transferring the heat becomes necessary. This can be done by direct radiation as in the case of a fire, by induced air currents as in conventors, by fan-produced air currents, or transfer media such as oil and water. All these methods have the one common drawback in that there is a loss of heating efficiency to a varying extent.

Now there is a new product, Mhoglas, made by Hunting Mhoglas Ltd., of Luton, England, which it is claimed overcomes this efficiency loss and offers exactly the advantage which wire heaters lack. The material is made by a process which makes glass fabric electrically conducting. This is because, as the element itself is in sheet form, the whole of which heats evenly, the heat generated is also in sheet form.

Among the wide varieties of use to which Mhoglas may be put are heated panels, skirting boards, floors, tables and walls. It has also been used in tests with great success in solving aircraft de-icing problems, and in the plastics industry.

One important claim for the new material is that it cannot cause a burn if touched, a great safety point in any form of panel heating. The normal running temperature is that of hot, though not boiling water.

● NOTES FROM BRITAIN

New Test-House For The Conway Pod. Those airlines which have specified the Rolls-Royce Conway by-pass engine for their Boeing 707 airliners will have a complete Rolls-Royce power plant — engine, accessories, thrust reverser, noise suppressor and the pod which houses them all. In order to test the complete pod as a unit, Rolls-Royce Ltd. has constructed a special test-house at the Flight Test Establishment at Hucknall, England, and has already carried out more than 200 hours' running with the Conway pod exactly as it will be installed in the aircraft except that until recently the thrust reverser and noise suppressor were not fitted.

The test-bed was developed jointly by Rolls-Royce and Heenan and Froude Ltd., and is equipped to measure both forward and reverse thrust. The power-plant is suspended from a bridge-type cradle by an actual Boeing strut, and through this strut all engine controls and instrumentation, starter and other air feeds are led exactly as in the aircraft.

This in itself has been a difficult task, for in addition to the normal services, the strut has also had to contain the leads from more than 60 pressure tappings and a similar number of temperature indicators used in engine development runs. In all there are nearly 3,000 electrical leads passing through the strut.

The test cradle is suspended on four vertical spring plates and is restrained by electric load cells from which thrust measurements are obtained. By mechanically loading the craddle against the load cells it is possible to read both forward and reverse thrust.

The load cells used on this installation have been developed by Davey and United to the requirements of Rolls-Royce. The load cell system has been chosen principally on account of the accuracy of measurement it permits without interference from ambient temperature variations. The total movement of the engine cradle over the whole power range from 10,000 pounds reverse thrust to 20,000 pounds forward thrust is only 0.006 inches which virtually eliminates inaccuracies arising from varying positions of the cradle suspension, ambient temperature interference is diminished by surrounding the cells with an oil jacket and a water jacket, and such variations as remain can be compensated in the load cell circuit.

As a result an accuracy of 0.1 per cent is attained over the full scale of —10,000 pounds to 20,000 pounds thrust, and an error of less than ten pounds thrust is guaranteed when extended scale readings are taken.

Mechanical Slipway For Tankers. A new mechanical method has just been designed for overhauling large tankers without the use of elaborate dry-docking facilities. It consists of a slipway equipped with a series of flange-wheel carriages fitted with keel blocks, which runs down from the shore on to a thick concrete runway beneath the water. A tanker coming into "dock" for a refit is brought on to the slipway in much the same manner as an airliner coming in to land.

A series of buoys or siting poles are located in the water so as to form a plainly visible "run-in" on to the slipway. The tanker arrives at high tide and is anchored to the correct buoy. As the tide recedes, the tanker slowly lowers on to the keel blocks below. When completely bedded down, it is hauled up the slipway on the carriages.

The motive power is supplied by electric motors which are located in pits well above high water level. The use of the slipway is restricted to tankers of up to 50,000 tons displacement. This mechanical slipway has been developed by Mitchell Engineering Ltd., of Bedford Square, London, W.C.1.

● OTHER SOCIETIES

Calendar

(Continued from Page 140)

Engineers Joint Council

and Sixteenth Group Steering Committee, National Conference on Air Pollution, Nov. 1958.

Institute of Aeronautical Sciences

National Specialist Meeting on Dynamics and Acroelasticity, Texas Hotel, Ft. Worth, Tex., Nov. 6-7, 1958.

Institute of Aeronautical Sciences

Wright Brothers Lecture, Maurice Roy, on French Aeronautical Research, Natural History Building, Smithsonian Institution, Washington, D.C., Dec. 17, 1958.

Illinois Institute of Technology

Industrial Engineering Conference, Illinois Institute of Technology, Chicago, Dec. 4-5, 1958.

Illinois Institute of Technology

Fourth Annual National Construction Industry Conference, Sherman Hotel, Dec. 10, 11, 1958. Write: R. T. Mijanovich, Armour Research Foundation, 10W. 35th St., Chicago 16, Ill.

American Association for the Advancement of Science

Annual Meeting, Hotel Statler, Washington, D.C., Dec. 29, 30, 1958.

Associate Committee on Soil and Snow Mechanics of the National Research Council of Canada

Twelfth Canadian Soil Mechanics Conference, University of Saskatchewan, Saskatoon, Dec. 8, 9, 1958.

Chemical Institute of Canada

Symposium sponsored by the Organic Chemistry Subject Division, University of Ottawa, Ont. Dec. 8, 9, 1958.

National Concrete Products Association

Tenth Anniversary Convention, King Edward Hotel, Toronto, Jan. 26-28, 1959.

American Society of Heating and Air-Conditioning Engineers

Sixty-fifth Annual Meeting, and the 14th International Heating and Air-Conditioning Exposition under the auspices of A.S.H.A.E., Philadelphia, Pa., Jan. 26-29, 1959.

Institute of Physics

British Nuclear Energy Conference, Symposium, London, on "Nuclear Fuel Cycles", Jan. 22, 23, 1959.

National Association of Corrosion Engineers

Canadian Region, Eastern Meeting, Montreal, January 12-14, 1959.

Western Meeting, Calgary, Alta., Feb. 11-13, 1959.

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MEMBERSHIP

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THE PRIME MINISTER

VICTORIA

I am grateful for this opportunity to pay tribute, perhaps all too infrequently paid, to the professional engineers of Canada, particularly those whose work has been closely connected with British Columbia's development during the past 100 years.

I am proud, too, that the Engineering Institute of Canada, the largest and oldest association of engineers, has seen fit to devote this issue of its official organ, the Engineering Journal, to the Province of British Columbia.

We forget sometimes that a large part of the real work and the enormous responsibility for the physical development of a country or a province is borne by the engineer. In both government and private industry others may set the policy but the engineer conceives and builds the bridges, the railways, the highways, the pipelines, the hydro-electric dams, the transmission lines, the buildings and the industrial plants. Without his skill we would live primitive lives, without his knowledge we would stand still and without his advice we would founder.

Over the past century British Columbia has been a particular challenge. Beneath its rugged crust, along its rivers and on its surface are untold resources, but only through the engineer's skill have these become available to us.

If we appear sometimes to forget the contribution made by the professional engineer, it is not because we do not appreciate it, but perhaps because the high standard of performance through the years has made us take it for granted. And we know that much of the present and future physical development of British Columbia is in his skilled hands.

Perhaps the words of Historian Judge Howay in describing the work of the Royal Engineers on the original Cariboo Highway nearly 100 years ago would not be out of place here and, indeed, could be applied to anyone of the many great engineering projects today. He said "This road was the pride of British Columbia, and a source of wonder and admiration to its visitors, who were loud in their expression of surprise at the daring conception and skillful execution of the work".

Prime Minister of British Columbia

BRITISH COLUMBIA

AN HISTORICAL SKETCH

R. H. Roy *Provincial Archives, Victoria, B.C.*

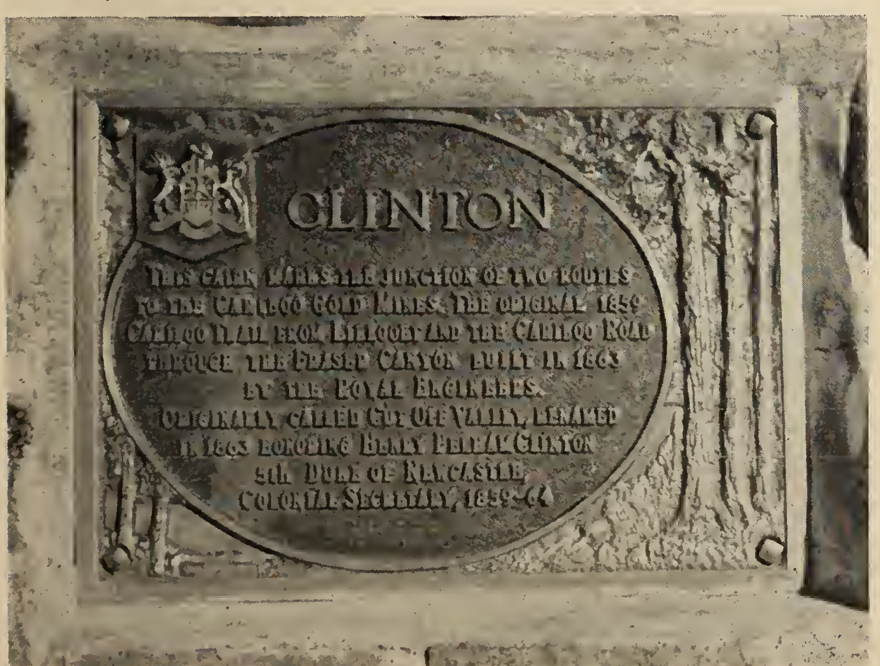
THIS YEAR British Columbia is celebrating its one hundredth birthday. The date for this centenary is based on an event which took place at Fort Langley, B.C., on November 19th, 1858. At this Hudson's Bay Company post on the bank of the Fraser River were gathered a handful of men who, at the command of Queen Victoria, proclaimed the mainland to be a Crown Colony of Great Britain, giving it equal status with Vancouver Island, its colonial senior by nine years.

This event took place in what was one of the most isolated colonies of the British Empire. To the west the nearest colony was Hong Kong, some 6,500 miles away. To the east, across 2,000 miles of mountain and prairie, were the older Canadian colonies. Between the capital of British Columbia and London, the heart of the Empire, were 14,500 miles and months of sailing time.

The geographic isolation of British Columbia accounts for the fact that it was not until the middle of the previous century that any serious attempt was made to discover and chart the northern Pacific coast of the continent. Similarly, while time and distance were factors militating against discovery by sea, the great mountain ranges of the Rockies and Selkirks served as a barrier to the early penetration of the area by land.

Russia and Spain, both operating from ports opening upon the Pacific, were the first to send their ships along the Pacific Coast. In 1725 Vitus Bering, a Dane in the service of Czar Peter the Great, started on the first of two great expeditions which took him across Russia to Kamchatka. One of his tasks was to determine the eastern boundaries of the Czar's domain, and in so doing to find out, once and for all, whether a land bridge existed between Russia and North America. Bering, after skirting the Alaskan coast during his second expedition, perished when returning to his base at Petropavlovsk in 1741. It was his Lieutenant, Chirikoff, and those who came later, who established Russia's claim to Alaska.

Where the Cariboo Trail and the Cariboo Road meet: The Cariboo Road monument at Clinton, B.C.



An important result of these Russian explorations was the discovery of a hitherto unknown fur-bearing animal—the sea-otter. Pelts from this animal claimed a very high price in China, and as a result a lucrative maritime fur trade was established by the Russians from bases in Alaska.

Far to the south were the Spanish possessions in Mexico and Lower California which had been conquered during the 16th century. Although claiming the entire Pacific Coast by authority of the papal bull of 1493, Spain had been content to exploit the riches she had uncovered in the southern latitudes, and for decades had taken no serious steps to explore and settle the lands north of California. News of the Russian advances, however, coupled with the defeat of France in North America, resulted in a reawakening of Spanish interest in the Pacific.

The voyage of exploration by Don Juan Perez in 1774 represented the first move of Spain's new policy of expansion into the north Pacific. Operating from the Mexican port of San Blas, Perez was followed by other Spanish explorers such as Martinez, Heceta and Quadra. The contributions of these voyages to the knowledge of the northern Pacific, however, were limited, and it was not until the advent of Captain James Cook and Captain George Vancouver that a true outline of the islands and mainland coast of British Columbia emerged.

Although Great Britain's entry into the northern Pacific had been late, she came as the foremost maritime power in the world. Her ships were large, well-equipped, and captained by men whose ability and navigational skill were unmatched. Foremost among these was Captain

James Cook, an officer of the Royal Navy who had gained renown for his two famous expeditions in the South Pacific. In 1776, Cook was sent on a scientific and exploratory mission to the western coast of North America to discover, if possible, the long-sought Northwest Passage—the fabled waterway which supposedly connected the Atlantic and Pacific Oceans.

After voyaging around the Cape, Captain Cook, in *H.M.S. Resolution,* arrived off the coast of Oregon in March, 1778, and proceeded northward. Adverse winds and storms prevented his entering the Juan de Fuca Strait, but at Nootka Sound, on the western coast of Vancouver Island, Cook anchored his ship and became the first European to set foot on what is now British Columbia. Incidentally, while repairing his ships at Nootka, he was also the first to make use of the excellent timber for new spars and masts.

Although he sailed farther north, charting the outline of the coast to Bering Strait, Cook did not discover the Fraser or Columbia Rivers nor did he know that Vancouver Island was not part of the mainland. Cook's voyage, however, did reveal the commercial potentialities of the sea-otter trade with China, and when his journals were published in 1784, following the end of hostilities in Europe and North America, both British and American ships set out for the Pacific Coast to engage in this lucrative trade.

The maritime fur traders, as they were called, played an important part in the history of British Columbia. One of these men, the American sea captain Robert Gray, was to achieve fame as the discoverer of the Columbia River, an action which was to establish the claim of the United States to that part of the coast. Another, a British subject, Captain John Meares, was the first to build a ship —the *North West America*—in British Columbia.

The activity of the maritime fur traders was rudely interrupted in 1789 when Captain Martinez, of the Spanish Navy, arrived at Nootka to proclaim and enforce Spain's claim to the area. This proclamation, accompanied by the seizure of Captain Meares' vessels, resulted in a controversy between Great Britain and Spain which led both nations to the brink of war. Open hostilities were avoided when Spain, lacking the strength to enforce national aspirations, signed the Nootka Sound Convention in 1790, a step described as "the first express renunciation of Spain's ancient claim to exclusive sovereignty, navigation, commerce, and fisheries on the Pacific Coast of America".

In the following year the British government sent Captain George Vancouver, R.N., to continue and further the task of exploring and mapping the coast undertaken by Captain Cook, and also to accept the surrender of the lands and districts seized by the Spanish. It was Vancouver who, by his patience, determination and navigational skill, became the first to circumnavigate Vancouver Island and who, upon his return home in 1795, brought with him accurate charts which showed in detail the islands and coastline of Canada's Pacific Coast. Vancouver's discoveries exploded the myth of a North-West Passage, a myth which evaporated as did the former Spanish pretensions to sovereignty in the North Pacific.

So far we have dealt with the approach to British Columbia by sea. Yet it was only three or four weeks after Vancouver had sailed through Fitzhugh Sound in 1793 that, a few miles up a neighboring sound, Alexander MacKenzie completed the first journey made by a European across the continent.

The discovery of British Columbia by land was directly connected with the fur trade which, after 1760, fell from the French into the hands of the British. By this time the Hudson's Bay Company had been in existence for almost a century. The company had done comparatively little, however, to explore into the heart of the continent, a passive attitude which it was forced to abandon with the coming of "the pedlars". This was the derisive name given by the Hudson's Bay Company men to those independent fur traders from Britain's colonies bordering the Atlantic, who stepped in to exploit the fur trade in the area formerly held by the French. Within a few years the "pedlars" were to band together into loose organizations which, in turn, amalgamated in more permanent form as the North West Company.

From 1785 until 1821, the North West Company was to provide the Hudson's Bay Company with the most aggressive competition it was to experience in its entire history. Basically, it was a period when both companies, but especially the Nor'Westers, pushed farther and farther west in order to open the new, beaver-rich lands which awaited exploitation. No longer would the white men remain in their forts awaiting for the India[illegible] hundreds of miles to the tra[illegible] posts around Hudson's Bay and [illegible] Great Lakes. Instead the traders, [illegible] canoe and on foot, travelled into the wilderness bringing their goods to the Indians and reaped their rewards by hard work and shrewd bargaining. The Hudson's Bay Company had the advantage of a royal charter, strong financial resources and a sea route from London to its posts around the bay. To offset these advantages the North West Company, with its profit-sharing organization, depended upon

A Cariboo freight wagon leaving Ashcroft, B.C.

Barkerville—Main Street before the fire of September, 1868.

its business efficiency, its energetic, hard-driving partners, and the flexibility of operations it enjoyed.

It was the Nor'Westers who first entered British Columbia by the overland routes. Alexander MacKenzie, a partner in the North West Company, penetrated the mountain barrier by way of the Peace and Pine Rivers and, after weeks of toil and danger, this hardy Scotsman and his companions reached the Pacific near present-day Bella Coola in July, 1793. Their voyage by canoe and by foot is a saga by itself, and there are few knighthoods which have been won at such great risk and under such adverse conditions as that granted MacKenzie for his exploits.

The journey of MacKenzie to the Pacific Coast, although important historically, was unsatisfactory as a transportation route for the fur trade. Preliminary steps to undertake a new attempt were taken twelve years later by Simon Fraser. After establishing several trading posts in the Upper Peace River country—or New Caledonia, as he called it—Fraser, thinking he was on the northern reaches of the Columbia River, set out down the rushing, turbulent river which now bears his name. Fraser's amazing voyage down this waterway to the ocean was completed on July 2nd, 1808. Yet once more, despite his feats of endurance and leadership, this journey was a commercial failure. The river was not the Columbia, and further, it was obvious that the roaring currents, whirlpools and rapids of the Fraser River would not serve as a water highway for the fur trade.

While Fraser was exploring and penetrating the northern routes into British Columbia, David Thompson, also a North West Company fur trader, was making his way slowly and methodically into southern British Columbia. Thompson, famed as a cartographer as well as an explorer, was the first to travel the length of the Columbia River and to establish the first feasible route for the Nor'-Westers from the Pacific to the Great Lakes.

For over a decade, the North West Company dominated the fur trade on the Pacific slope, establishing numerous posts over a vast area. Although tapping rich beaver territories, the long, expensive journey back to the Great Lakes, together with the vicissitudes brought on by the keen competition of the Hudson's Bay Company, resulted in the amalgamation of the two competitors under the name of the Hudson's Bay Company in 1821.

Seven, or approximately half, of the posts mentioned above were located south of the present-day international border. West of the Rockies, the United States and Great Britain, by mutual agreement, jointly occupied the territory commonly called Old Oregon. The main events of British Columbia's history from 1821 until 1846 took place in this area, and revolved around the inability of the British fur trading company to stem the tide of American immigration into the rich farming country of Washington and Oregon.

It seems almost ironical that it was the hospitality offered the early American pioneers by Dr. John McLoughlin, the Chief Factor for the Hudson's Bay Company, west of the Rockies, which resulted indirectly in the success of the settlement of the Oregon country. This success in turn brought hundreds and then thousands of Americans over the Oregon Trail, and with them came the demand that this new land should throw off its dual sovereignty and be incorporated into the United States. The British hope of establishing the border along the Columbia River faded in proportion to American immigration, and in 1846 the boundary line was continued along the 49th parallel to the Pacific Ocean.

Sir George Simpson, who controlled the Canadian activities of the H.B.C., had foreseen this turn of events and, in order to provide an alternate headquarters for the fur trade on the Pacific, he ordered the construction of Fort Victoria on the southern tip of Vancouver Island. The location for this new post, the future capital of the province, was selected by James Douglas, who succeeded McLoughlin as Chief Factor in 1846.

Oregon, as we have seen, was lost by the failure of the British to settle there, and not unexpectedly there were many in Great Britain who had complained that the Hudson's Bay Company charter was in effect a major obstacle to the settlement and development of the Canadian West. When the company's licence had been renewed in 1838, a clause was inserted whereby the British Government retained the right to establish a colony within the company's territories to exclusive trade. Following the boundary treaty, therefore, Vancouver Island was proclaimed a Crown Colony and Richard Blanshard was commissioned its Governor in 1849.

Unfortunately, owing to the reticence of the Hudson's Bay Company as the colonizing agent, the geographic isolation from Great Britain, and the lure of California gold, few settlers came to Vancouver Island. As late as 1858, Fort Victoria was a small sleepy village of about 600 souls, the greater number of whom were present or past servants of the Hudson's Bay Company.

The discovery of gold on the Fraser River in that year brought about profound changes. When word of the gold strike reached San Francisco, the news spread like wildfire. During the Spring and Summer of 1858, some 25,000 Americans streamed into the Colony, eager to make their fortune, and caring little whether they did so under the Stars and Stripes or the Union Jack. This inundation of American gold miners swamped the small British population and there were fears that, unless prompt measures were taken, British Columbia might be annexed to the United States.

James Douglas, at this time Governor of Vancouver Island and Chief Factor for the Hudson's Bay Company, possessed those qualities of decisive action and firmness which quickly made it apparent to the gold miners that they were on British soil and subject to British laws and justice. Although his legal authority was limited to Vancouver Island, the British Government, informed of the situation, appointed Douglas governor of the mainland area also when it was proclaimed a Crown Colony at Fort Langley on November 19th, 1858.

To strengthen Douglas' hand, as well as to assist the new colony, the British Government sent out a small force of Royal Engineers under Colonel R. C. Moody. These men, many of whom remained in the colony when the force returned home in 1863, played a more important part in the development of British Columbia than their numbers might indicate. As surveyors, road and bridge builders, printers, town planners, et cetera, they performed the work which, in later years, would be undertaken by several governmental departments.

With the Royal Engineers based at New Westminster, and ships of the Royal Navy stationed at Esquimalt, Douglas had at his command the means of enforcing British rule in the colony should it be necessary. Yet these forces were never called upon to quell any serious disturbance, and part of the credit for enforcing British law in the colony is due to the colony's Chief Justice, Matthew Baillie Begbie. Begbie, sometimes called "the Hanging Judge", meted out justice with a swift and sure hand in the remotest parts of the gold fields, treating Canadians, British, Americans and Indians without fear or favour. The tales about him are legend, but there is no doubt that he demanded and received a respect for British law and justice which kept lawlessness in the colony at a minimum.

For the next decade both colonies depended almost entirely on gold mining as their chief source of revenue. From the Fraser the miners probed to the north and east, periodically making new strikes, and with each major strike setting off a new "gold rush". The later strikes were made in the interior of the mainland, and brought with them a demand for suitable transportation routes to the gold fields. The famous Cariboo Road to Barkerville, constructed through part of the colony's most rugged territory, was an example of the difficulties faced and overcome by the miners. In time almost every type of transport was used, and miners travelled on foot, on horseback, by ox- and mule-train, by stagecoach, by river paddle-wheelers, and even some by camel. The history of transportation in British Columbia is an epic in itself.

By the mid-sixties British Columbia was beginning to feel a recession as the peak of the gold rush period passed and miners left by the hundreds to prospect elsewhere for that elusive precious metal. Many remained, however, not as miners but as farmers and ranchers who were attracted by the rich valley lands in the interior.

A river boat at Emory's Bar near Yale, B.C.

The recession brought about the end of dual colonial government. In order to lessen the cost of administering two contiguous colonies, both were united under the name of British Columbia on November 19, 1866, with its capital first in New Westminster and then Victoria.

In the following year two events took place which were to shape the future political path of the colony. In 1867 the United States bought Alaska from Russia, thus placing the colony in a situation where it was exposed to the full blast of Americans' cry of "Manifest Destiny" and possible annexation. In the same year the eastern provinces confederated to form the Dominion of Canada, a new nation whose founders were already thinking in terms of a nation which would stretch from sea to sea.

Of the three choices open to the colony — annexation, confederation, of remaining a Crown Colony— British Columbia decided to pick the middle path, especially as confederation would bring with it the long-sought railway connection with the east. On July 20, 1871, the colony became the sixth province of the new Dominion.

The potential wealth of the new province was immense, but before its natural resources could be exploited it was essential to construct a network of roads and railroads throughout the province in order to transport the lumber, ores, agricultural produce, et cetera, to the markets of the world. It was not until 1885 that the Canadian Pacific Railway was completed from the Atlantic to the Pacific when the last spike was driven at Craigellachie.

The advent of the railroad, and especially the numerous branch lines constructed during the latter part of the last century, brought a surge of life to the economic development of the province. Villages grew into towns, heavy machinery was brought in to develop and increase the mining industry, settlers arrived to take up land throughout the province, and British Columbia, once a remote part of the British Empire, entered a new era of progress.

ONE HUNDRED YEARS OF ENGINEERING

Early in 1958 the Vancouver Branch of E.I.C. sponsored, in conjunction with the University of British Columbia, a competition for essays on an engineering subject. The first prize was awarded to **Gerald Gatz**, *Engineering I, U.B.C., for his essay, "One Hundred Years of Engineering in British Columbia". The text of this interesting contribution from an engineering student is published here.*

WITH THE cry of gold echoing across the western frontier in 1858, the watersheds seethed, not only with glistening torrents, but with humanity as well. A letter to James Douglas, Chief Factor of the Hudson's Bay Company and future Governor of the Colony of British Columbia, was to indicate the beginning of engineering in this province. Sir Edward Bulwer-Lytton, England's Secretary of State for the Colonies, wrote that he was sending an officer of Royal Engineers and a company of 150 men.

> It will devolve upon them (he wrote) to survey those parts of the country which may be most suitable for settlement, to mark out allotments of land for public purposes, to suggest a site for the seat of Government, to point out where roads should be made, and to render you such assistance as may be in their power . . .

In October 1858, Lytton wrote again to Douglas saying why Engineers had been chosen.

> The superior intelligence and discipline of this force, which afford ground for expecting that they will be far less likely than ordinary soldiers of the line to yield to the temptation to desertion offered by the goldfields, and their capacity at once to provide for themselves in a country without habitation, appear to me to render them especially suited for this duty; whilst their services as pioneers in the work of civilisation, in opening up the resources of the country, by the construction of roads and bridges, in laying the foundations of a future city or seaport, and in carrying out the numerous engineering works which in the earlier stages of colonisation are so essential to the progress and welfare of the community, they will . . . establish themselves in the popular good-will of the emigrants by the civil benefits it will be in the regular nature of their occupation to confer.

Lytton made a good choice. In the short period of five years, the accomplishments of this little band of men were staggering.

This detachment of Royal Engineers was a versatile body. They were not long at sea before editions of *The Emigrant Soldiers' Gazette and Cape Horn Chronicle* were distributed throughout the vessel—"published at the Editor's Office, Starboard Front Cabin, *Thames City.*" The spirited paper contained good poetry, short stories, puzzles and items of interest to all on board. The publication was later undertaken by John Robson of New Westminster.

On land, the corps' industriousness created a swirl of activity. Organization, construction, expansion, these were not dreams; they were facts! The new capital of New Westminster was laid out; wagon roads appeared; the towns of Hope and Yale were surveyed; sites at Clinton and Quesnel were cleared; and by 1860, mills were seen on the lower Fraser. The birth of British Columbia's valuable lumber trade took place. Fort Victoria, on the nearby Colony of Vancouver Island, would not be outdone. Here it was that the Phoenix Brewing Company first laid foundation. Shipbuilding was taking place at Esquimalt.

One finds that most of the important tasks in the colony were performed by the Engineers. They published the first maps; they established a systematic meteorological service; they erected the first churches; they helped locate the forty-ninth parallel. They built the first mint. The Royal Columbian Hospital owes its existence to this force. If for no other reason, the people of this province became indebted to them when their Colonel, Richard C. Moody, set aside, as a military reserve, what was to become known as Stanley Park.

In 1865, two years after the dispersion of the Royal Engineers, the Cariboo wagon road was completed. This was the year that the news of Lincoln's assassination buzzed across the territory. Telegraph poles were becoming familiar sights along the right of way. In six more years the colonists on the Pacific Slope would begin a lonesome vigil for a through railroad from the East.

Eight years of waiting, then old mining camps, camps that had been stilled by the swift depletion of surface gold, sprang to life again. Railroad men appeared. Through the Fraser Canyon, fills and cuts were made, tunnels bored. Bridge and trestle came into view. "No such mountain work had ever been attempted in Canada before," said H. J. Cambie, one of the engineers. Near Revelstoke, at Craigellachie, on November 7, 1885, east met west, and the last spike was driven.

At the turn of the century, the rush to the Klondike indicated a need for improved communication. Telegraph lines reached Dawson Creek. This success was in keeping with the times, for Vancouver Island was now linked to Australia by trans-oceanic cable. Rail development again demanded public attention. Two years before the first World War, plans

The Consolidated Mining and Smelting Company's smelter and metallurgical works at Trail, as it appeared in 1949. *Provincial Archives*

were laid for the Pacific Great Eastern to link Squamish, Quesnel and Prince George. The Kettle Valley line of the Canadian Pacific Railway was conceived. This line is now famous for its high trestles through the Coquihalla Pass, masterpieces of engineering.

By 1927, highway construction had replaced railroad building. The Cariboo Highway, completed by the Provincial Government, is only one example of work done at this time. The old Colonial government's wagon road, started by the Royal Engineers, had been destroyed during the period of railway construction, and a new highway to the interior was necessary.

The completion of the Panama Canal stimulated industry, but only by the tireless efforts of science and engineering were new processes introduced. When the Provincial Engineering Acts were passed in the year 1920, tighter control was gained on design and function of engineering operations. Safer and more efficient methods were imminent. A far greater degree of protection to public and to industry was in prospect.

Hydro-electric stations were feeding "white-coal" to the greedy mines and mills. During this era, "Knewstubb of Nechako", chief hydraulic engineer of the Department of Lands, discovered the vast power potential of the chain of lakes at the source of the Nechako River. He envisioned a 2,850 foot drop to the sea by great amounts of water diverted through the Coast Range. Twenty years would pass before the Aluminum Company of Canada would begin to harness this large resource. Knewstubb's discovery will ultimately become one of the world's largest privately - financed power projects, producing close to two million horsepower.

Wartime demands once again directed intensive research efforts. At Trail, the Consolidated Mining and Smelting Company's scientists and engineers worked around the clock improving metallurgical processes. New industries appeared on the horizon almost overnight. Old ones expanded. Shipbuilding received a boost. Petroleum refining obtained prominence. British Columbia airports demanded prestige. At the end of the conflict, engineers did not become idle. New consumer goods had to go on the market.

With the view of making more and cheaper electricity available, the British Columbia Power Commission was organized in 1945. The John Hart project at Campbell River was soon developed. Conductors, supported by steel towers one-sixth of a mile apart, transmitted energy southward as far as Victoria.

Private enterprise felt no restraint. Projects of the British Columbia Electric Company are known the world over. The Bridge River development is one of the most recent and most gigantic. Its power capacity made practical the erecting of one of the world's longest overhead cable-crossings, on the Powell River transmission line, a 10,100 foot span over Jervis Inlet. The unique submarine cable, now supplying 12,000 kilowatts at 130,000 volts to Vancouver Island, was so large an undertaking that British Insulated Callender's Cables Limited, of Manchester, had to rebuild part of their factory in order to produce continuous lengths up to seventeen miles. According to Thomas Ingledow, vice-president and executive engineer for the British Columbia Electric Company, "It is a milestone in the history of engineering." The investment that this company has made in developing water power is again indicated by the Cheakamus development, designed as the world's largest remotely-controlled hydro-electric plant — 140,000 kilowatts "put on the line" in 1957. The confidence that this company has in the economy of the province is signified by a proposed 1958 budget of $98,600,000, designed for construction and improvements. For communication, the B.C. Electric turns to the British Columbia Telephone Company for a subscription of over 1000 locals.

Tremendous advances in the field of communications is evidenced by the micro-wave radio relay network now being installed for the Northwest Telephone Company. From reports, this company's mountain cable car was as thrilling to build as it is to ride.

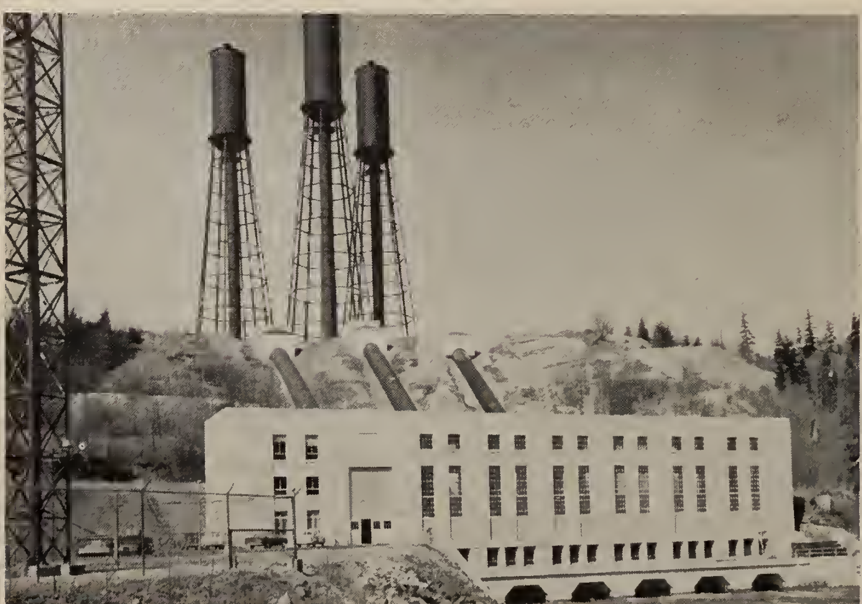
Projects like the Deas Island tunnel, the completion of the Pacific Great Eastern Railway from Squamish to Vancouver and from Quesnel to Prince George, the Upper Levels Highway from West Vancouver to Horseshoe Bay, are part of our daily conversations. The Granville Street and Oak Street bridges are no less to be admired than the Lions Gate, an engineering wonder of twenty years ago.

The controversial Rocky Mountain Trench concept could develop four million horsepower, say engineers of the British Thompson-Houston Company. Whether or not this dream will develop to its conceived conclusion remains to be seen.

Regardless, the province's industries will continue to utilize the abilities of many engineers graduating from the University of British Columbia's engineering faculties. Might it be said of them in years to come, as it has been said of engineers in the past,

> They have made their mark, and it will be seen by future generations, whether in throwing a pathway across a foaming torrent or in cutting a highway through the towering mountains of everlasting rock.

The John Hart Power Plant, Campbell River, B.C.



ENGINEERING BRITISH COLUMBIA'S FORESTS

R. G. McKee

IN THIS, British Columbia's Centennial Year, there is a general sense and appreciation of history and its significance abroad in the land.

As more and more of this Province's past unrolls, via all types of communication media, the place of the forests and their impact on and control of the social and economic development of Canada's third largest province, becomes increasingly noticeable. No one group, however, is more intimately involved in this pattern of evolution than is the Provincial Forest Service, charged as it is with the administration, in the general public interest, of the most vital single natural resource in British Columbia—its 200,000 square miles of forest land.

British Columbia had a rough and rowdy birth. Yet, coincidental with the influx of the rough gold-seeking transient population, were the true settlers who had made the tortuous trip around the Horn to carve a new and better life in this forbidding land. It was this group, whose efforts gradually began to turn the tide towards stability and respectability and the development of one of the world's most spectacular industries.

Far back in British Columbia's forest history, it is recorded that it was Captain James Cook, who became B.C.'s first white-skinned logger, as a result of his decision to refit his two ships *Resolution* and *Discovery* in the shelter of Nootka Sound, on the West Coast of Vancouver Island, in March, 1778. Cook's seamen went ashore and for four weeks busied themselves fashioning and fitting new spars and masts. Subsequently, it became common practice through the years for many of the trading and exploration ships operating in what are now British Columbia waters to refit in a similar manner.

None of these uses of Douglas fir was, in a true sense, a commercial use. However, this was soon to come.

In the words of the Honourable Gordon McG. Sloan, when Chief Justice of British Columbia and acting as Royal Commissioner on Forestry in 1956 ". . . the earliest explorers and pioneer settlers found in this Province vast and seemingly limitless forested areas, in greater part composed of tall and lordly trees . . . The first reported commerce in timber was in 1788. In that year Captain John Meares loaded a vessel with furs and a deck-load of spars for the China trade."

Although these and other historical events are interesting, they bear little real relationship to the sequence of forest administration development which started, in a small way, to take shape about 1865.

This was the year before the Mainland of B.C. and Vancouver Island joined together to become the Crown Colony of British Columbia. Prior to this period, forest lands were widely regarded in the public mind as of little or no value, possibly because there appeared to be so much of it. Timber lands could be acquired by outright purchase and Crown grant in the same way as any other Crown Land, and for the same price. The land was the thing—the timber, a bit of a hindrance.

However, the Land Ordinance of

*An article prepared by the Public Information & Education Division, B.C. Forest Service. Provided through the courtesy of R. G. McKee, Deputy Minister, B.C. Forest Service.

1865, introduced for the first time the system of selling timber cutting rights on Crown land without alienating the land itself. This was the important precedent that has established an over-all public control over the vast majority of forest land in British Columbia that obtains to the present day when some 92 per cent of productive forest acreage is held by the Crown. It was, of course, also the first step towards placing almost the entire responsibility for managing the forests on the shoulders of the Crown.

The intent behind this move was undoubtedly to gain Crown Revenue and promote the establishment of a forest industry, but it was not accepted without question.

To quote again from Hon. Mr. Sloan's Royal Commission Report:

"In the following years, cutting rights took various forms and were subject to varied conditions. It was an uneven and somewhat complex development, motivated by conditions thought impelling at the time these various forms of tenure were devised. To conclude that the earlier settlers, who had a hand in framing the forest laws and policies of those days, were, in so doing, deliberately thinking in terms of generations ahead is, I think, with respect, to attribute to them an unwarranted prescience. Early administrations were, in my view, motivated by the immediate objectives important to the era in which they lived. They were confronted with the critical necessity of obtaining Crown revenue and of finding means to encourage the utilization of forest products. The developing pattern of Crown ownership was the consequential result and not the design of their pioneering policies."

—and thus, the early stage was set.

It is interesting to note that the next major developments in forest administration in the province arose out of public horror over forest-fire losses. Early in this century, the province suffered from a terrible scourge of forest fires, not uncommonly of incendiary origin. The matter finally came to a head in 1909 when the city of Fernie, B.C., was wiped out by a forest fire. This resulted in the appointment of the first Royal Commission on Forestry in this province under the Hon. F. J. Fulton. A year later the Commission reported, and one of their principal recommendations resulted in the enactment of the "Forest Act", which in turn provided for establishment of the Provincial Forest Branch of the Department of Lands in 1912.

The original Forest Branch was primarily a fire-fighting agency with a modicum of staff and even less in the way of funds. It also had the responsibility of disposing of Crown timber through timber sales and collecting the Stumpage and Royalty fees for the Crown.

As is so often the case, when wise and dedicated men are needed, they seem to appear. Fortunately for British Columbia's future development, they appeared at this juncture and it was not too many years before their counsel on the wider implications of forest administration and conservation began to become manifest through law.

This trend towards greater understanding and appreciation of the absolutely vital role of the forests in British Columbia's daily economic life was underlined by a second Royal Commission in 1945. This has been followed by the 1956 Royal Commission, both under the Hon. Gordon McG. Sloan, now Forestry Advisor to the Government of British Columbia.

These Commissions, plus periodic heavy fire seasons and the passage of the industry from oxen to horsepower, through steam power to the present-day Diesel, with a parallel expansion of world export trade, brings us through economic depressions and booms, and two World Wars, to the massive but diversified and vastly complicated economic structure that constitutes the forest industry of today.

The giant that is the forest industry in 1958 is worthy of consideration if one is to gain any kind of a true appreciation of the administrative problems of the Forest Service. Firstly, it is a giant with a dual personality divided roughly into a massive, more or less, rigid Coastal industry accounting for approximately 65 per cent of the total annual cut, and the smaller, more fluid, somewhat seasonal Interior industry. Some 70,000 persons are directly employed in the forest industries of the Province and 40 cents of every dollar in circulation within the Province has its origin in the forests. Of Canada's total net value of forest industry production, 66 per cent originates in British Columbia. Over 60 per cent of all lumber produced in Canada comes from this Province. The annual cut in B.C. amounts to 5.6 billion board feet and the estimated value of production has averaged over $500,000,000 per year for the last decade with a peak yearly value of $631,000,000, in 1955.

The administrator is concerned not only with the maintenance of the industry in a vigorous and healthy state, but must also be keenly aware of the effect such a massive industry has had, is having, and is likely to have on the welfare of the prime resource itself.

It is generally agreed that this

Portable Spar Tree used in coastal B.C. operations is now being widely used. Goose-neck loader lifts logs on to trucks after they are yarded in by spar tree.

Province is richly endowed with some of the finest large forests in the British Commonwealth. Latest survey and inventory figures gathered over the past 7 years assisted in part by the Federal Government under the terms of the "Canada Forestry Act", provide the basis for a comprehensive assessment of the dimensions of this resource.

The following are some of these facts:—there are 118 million acres of commercial forest in British Columbia carrying 306 billion cubic feet of sound wood; the net annual growth amounts to 2.3 billion cubic feet; 2.2 billion cubic feet are lost each year through fire, insects, disease, and other factors.

These gross figures give an idea of the size of the problem, but not of the complexity of management.

A loaded truck leaving the 260,000-acre Willow River sustained yield unit over a forest development road. *B.C. Forest Service*

A resource is only a resource when it can be utilized to the benefit of man. So, in the matter of forest management, one must consider the key factor of accessibility. An accessible forest is considered to be one that can be harvested commercially at a fair profit at any particular time. This means that accessibility is not only related to topography and physical availability of markets, but also to the market prices themselves.

It stands to reason that when log and lumber prices are good, the operators can afford to go further from the market for their raw products, which has the effect of increasing the accessible wood supply. As the market drops generally, or in connection with specific species, the periphery of accessible supplies is automatically reduced. Thus, the operator is forced to return to those areas where logging has been going on for many years. Sometimes he finds insufficient timber available to support this investment. Sometimes he finds just sufficient to keep in business in the hopes that the market will improve and allow him to venture further afield. In this latter case, which was becoming more and more common a decade ago, increasing pressure is brought to bear on a small proportion of the productive forest area. Regional overcutting can easily develop under such circumstances and the annual harvest greatly exceed the ability of the forest estate to produce. This is one of the administrator's greatest problems and has brought about the spectacular shift from a straight cut-it-where-you-can-and-get-out philosophy, to a point where almost 50 per cent of British Columbia's annual forest harvest originates on land operated under some system of sustained-yield forestry.

Table I. Estimated Value of Production, Including Loading and Freight within the Province, 1948–57

Product	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	Ten-year Average, 1948–57
Lumber	$219,289,000	$206,228,610	$303,384,304	$278,904,266	$280,006,490	$279,979,507	$270,109,948	$348,264,190	$328,262,772	$275,373,764	$278,980,285
Pulp and paper	73,989,000	68,482,241	78,739,573	135,167,761	129,238,520	135,871,797	156,178,180	166,902,992	176,295,267	177,431,513	129,829,684
Shingles	25,094,000	16,881,240	37,502,958	32,537,442	23,878,880	26,700,153	28,077,416	29,488,730	24,407,817	18,421,952	26,299,059
Boxes	6,129,000	3,424,268	3,837,067	4,062,133	2,367,450	1,810,376	1,481,051	1,374,984	647,112	1,089,400	2,622,284
Plywood	22,430,000	21,500,000	26,250,000	34,500,000	36,572,000	45,240,000	53,000,000	68,000,000	80,000,000	71,845,000	45,933,700
Piles, poles, and mine-timber	4,158,000	4,470,379	5,127,681	5,805,745	9,540,340	8,646,611	5,087,052	6,283,909	9,301,902	12,834,152	7,125,577
Cordwood, fence-posts, and lagging	1,671,000	2,058,200	2,189,249	2,349,720	2,675,870	2,581,806	2,282,996	1,447,950	1,391,960	919,538	1,956,829
Ties, railway	671,000	467,127	281,308	633,089	963,200	669,007	445,777	306,625	615,491	1,068,280	612,090
Additional valne contributed by the wood-using industry	1,800,000	2,000,000	2,250,000	2,812,500	2,530,000	2,530,000	2,530,000	2,530,000	2,750,000	2,500,000	2,423,250
Laths and other miscellaneous products	1,598,000	1,454,000	1,723,616	1,994,340	2,164,660	2,688,007	1,845,901	1,595,900	1,306,988	986,082	1,735,749
Logs exported	6,435,000	4,029,069	5,741,784	4,981,597	5,401,410	4,514,777	5,918,306	4,413,508	2,342,700	1,343,090	4,512,124
Pulpwood exported	29,000	139,200	741,128	99,375	236,900	37,296	85,716	480	—	—	136,910
Wood-chips exported	—	—	—	—	—	—	—	—	—	6,875,000	687,500
Christmas trees	470,000	445,965	583,549	939,390	912,700	999,159	968,047	1,085,045	1,258,443	1,126,918	878,922
Cascara bark	23,000	9,250	18,925	20,572	18,130	20,160	12,393	5,249	6,511	14,880	14,907
Totals	$363,786,000	$331,589,549	$468,371,142	$504,807,930	$496,506,550	$512,288,656	$528,022,783	$631,699,562	$628,586,963	$571,829,569	$503,748,870

Table II. Paper Production (in Tons), 1948–57

Product	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	Ten-year Average 1948–57
Newsprint	327,764	378,355	388,191	385,172	428,832	501,083	536,656	560,993	595,717	583,850	468,661
Other papers	79,446	83,927	89,437	99,409	92,777	96,853	110,461	110,880	112,299	157,872	105,036

In addition to 694,119 tons of pulp manufactured into paper in the Province, 605,984 tons were shipped out of the Province during the year.

This then, the story of sustained-yield forestry and the attempts to overcome the imbalance problems with their regional overcuts while other good forest stands remain untouched, is the forest story of the Centennial Year in British Columbia.

There are four principal vehicles by which forests in British Columbia may come under sustained-yield management designed to ensure the continuance of a regular forest harvest from such areas forever. The largest acreage is managed by the Forest Service as "sustained-yield units". Second is the programme of co-operative management, whereby an operator accepts the responsibility of managing specified Crown lands in conjunction with his own holdings. The owner of forest land is also encouraged to practice sustained-yield forestry through tax concessions under the "Taxation Act". Finally, are the farm woodlots which are designed to provide employment for the farmer and his equipment in off-seasons.

Although each of these four types have different administrative techniques and mechanics, they all have a common goal—the securing of the forest crop for the future and the resultant increase in permancy to the industry as a whole and dependent communities in particular.

Probably the fundamental difference between the types of sustained-yield operations is that tree farm licences, tree farms, and farm woodlots, are operated by private companies or citizens under Forest Service supervision, while the sustained-yield units are planned and developed by the Forest Service, and the timber put up for competitive bid at public auction.

As at 31 December, 1957, there were 58 sustained-yield units covering 29,277,000 acres of productive forest land with an annual allowable cut of 334,440,000 cubic feet; twenty-three tree farm licences covering 4,858,000 acres with an annual cut of 191,272,000 cubic feet; a total of 70 tree farms and farm woodlots with a combined productive area of 541,800 acres yielding 26,608,000 cubic feet per year. In all, over 34,000,000 acres of productive forest land were under sustained yield management capable of producing a continual crop of 551,000,000 cubic feet per year—about 50 per cent of the current provincial cut. These totals have increased somewhat in the interim.

The tree farm licensee is required to manage both his own and the Crown land allotted in accordance with the principles of sustained-yield, and no other reason or object is considered sufficiently important to warrant the issuance of a licence. At any time the licensee can lose his deposit or even his licence and investment if it can be shown the operation as carried out is breaching the contract provisions.

The sustained-yield units have precisely the same objective as the tree farm licence but, where the latter is managed by a company, the former is managed by the Forest Service.

A method of log transportation on the B.C. coast is by self-dumping barges. By flooding tanks on one side, the barges heel over and dump their load.

A sustained-yield unit is a manufacturing plant producing wood in the form of trees. One of the first things the administrator has to determine is the amount of wood that will be produced annually in perpetuity. This is the annual allowable cut and before it can be calculated, as complete a picture as possible of the resources must be available. Then the forest manager must decide on the method of harvesting and type of management; e.g., what stands are to be managed as uneven-aged or as even-aged and what stands are to be clean-cut or partially cut?

On the Coast, most forests are managed as even-aged stands and are logged on a clear-cut basis. The formula most commonly used on the Coast is one proposed by Mr. E. Hanzlick which states that if the old growth timber is divided by the number of years it takes the timber to reach to maturity and added to that the growth per acre multiplied by the number of acres of immature growing stock, the answer is the annual allowable cut. Yet this answer, based as it is on present-day standards of utilization, is constantly subject to change. Indeed, as forest management becomes more intensive and widespread throughout the Province and as utilization standards increase as a result of products research and improved machinery, the annual allowable cut in any managed area should change in order to maintain maximum utilization of the resource.

Annual allowable cut is also further complicated by the effects of forest fires, disease, and insect attacks, and the rate of natural regeneration.

When it is considered that this type

Table III. Number of Acres Managed and Operated under Approved Working Plans, 1948-57

Year	Tree Farm Licences		Christmas-tree Permits		Farm Wood-lots		Sustained-yield Units		Total Acres
	Number	Productive Acres	Number	Productive Acres	Number	Productive Acres	Number	Productive Acres	
1947	...	....	82	32,139	...	......	...	....	32,139
1948	1	795,208	107	40,767	...	......	...	....	835,975
1949	2	1,081,711	118	43,778	...	......	...	....	1,125,489
1950	7	1,668,663	129	45,360	...	......	...	....	1,714,023
1951	10	1,953,754	135	47,250	3	452	...	....	2,001,456
1952	13	2,071,918	145	49,986	5	727	...	....	2,122,631
1953	14	2,158,988	163	64,835	20	4,571	24	5,649,162	7,877,466
1954	19	2,788,313	174	68,689	25	5,549	28	7,019,759	9,882,310
1955	23	4,685,492	209	72,603	29	6,455	33	9,328,447	14,092,997
1956	23	4,680,846	221	76,457	37	8,320	47	21,667,410	26,433,033
1957	23	4,871,237	283	80,651	44	10,488	58	28,820,776	33,783,152
Ten-year average, 1948-57	13	2,675,604	168	59,038	16	3,656	19	7,248,555	9,986,853

of close control is now required over some 35,000,000 acres, the magnitude of the administrator's task can be imagined.

Every facility of the Forest Service is committed to a greater or lesser extent to make this sustained-yield programme work. The Research, Working Plans, Management, Protection, Reforestation Divisions and, to possibly the most spectacular extent, the Engineering Services Division, continuously labour to make B.C.'s forest future secure.

The engineers have come into their own in the planning and execution of the details that are involved in forest management and possibly more than any other profession personify the "new look" in British Columbia's forests.

With the advent to sustained-yield forest management, access roads became one of the first and primary concerns of forest administration. The Government has, therefore, undertaken the construction of forest development roads in the sustained-yield units to facilitate sound forest management practice in these areas and to make large tracts of inaccessible timber available for operators.

One task of the Engineering Services Division is to locate, design, and supervise the construction or construct these forest development roads. In addition to the access road programme, the Division supplies a large part of the engineering knowledge required for numerous phases of Forest Service administration. It works in close co-operation with the Timber Management Division, for instance, in locating roads for large timber sales. Other forest engineering problems on timber sales are investigated for Management Division and District personnel. The "Design" section assists with the design and construction of buildings and structures requiring engineering as well as architectural knowledge. Construction crews of the Division, under the direction of the engineers, from time to time perform a variety of tasks for the Districts and other Divisions ranging from the driving of a few foundation piles to a water system involving a small dam and a complicated distribution system. Forest development roads vary from public highways for a number of reasons.

(1) They are constructed for the purpose of making an area accessible for the management of the forest, not for the public to travel between localities. The traffic is largely of a specialized nature concerned with the utilization, protection, improvement or general administration of the forest. The volume of traffic can be calculated from known factors, particularly the annual field of forest products.

(2) They are designed and located to various standards according to the volume of timber and the quality of the site in each part of the forest and in conjunction with the most efficient utilization plan. By contrast the location and standard of a public road is determined largely by the position and size of settlements and the shortest route between them.

(3) They are designed as haul roads (adverse grades are designed on the basis of hauling cost and construction cost).

(4) They are designed for use by experienced truck drivers (minimum width and visibility as determined from construction costs and the traffic volume).

(5) They are constructed as permanent roads for a definite traffic volume which will increase very little. The roads will not be reconstructed every 20 or 30 years as are public highways where the traffic volume increases steadily and reconstruction is necessary.

(6) The standard of road is determined from the calculated traffic volume and hauling cost so as to give the lowest transportation cost for the forest product (that is the smallest sum of amortization charge, maintenance cost and hauling cost).

(7) The capital cost is amortized over an economic period comparable to that used by industry to determine the feasibility of each project; based on the average utilization costs for the region.

(8) The amortization charge is computed on the unit of measurement of the forest products to be hauled, and must not exceed the average cost per unit on local timber sales, that is, the cost in private competitive business practice. It is possible to construct permanent roads, on which forest products can be hauled more cheaply for the same cost that some operators are now building poor temporary roads.

(9) The cost of the road to the Crown will be repaid by the increased value of the timber.

Since 1950, the Engineering Services Division has completed construction of well over 153 miles of development road, has located another 350 miles and carried out reconnaissance on 700 miles of possible routes.

All this engineering of British Columbia's forests is directed towards correcting an historic imbalance and unhealthy concentration of industry in the easily accessible areas. The small and medium sized operator now gets a chance to find and log new timber supplies by using Government-constructed access roads.

No one with any understanding of the situation could possibly say that the sustained yield job is finished in B.C. It is far from finished. As a matter of fact it will probably never be finished — it is a continuous job. Nonetheless in the past 10 years, more, far more has been done towards securing the forest future of the Province than in the previous century. If we can continue towards our goal over the next decade without too many setbacks, one of the prime forest areas of the western world will have been converted to one massive sustained-yield unit for the betterment of industry and the nation as a whole.

Table IV. Total Scale of All Products from Managed Lands, 1948-57

Year	Tree Farm Licences		Christmas-tree Permits		Farm Wood-lots		Sustained-yield Units		Total	
	Number	Cubic Feet	Number	Number of Trees	Number	Cubic Feet	Number	Cubic Feet	No. of Christmas Trees	Cubic Feet
1948	1	....	107	157,944	...	.....	...	....	157,944	....
1949	2	....	118	165,035	...	.....	...	....	165,035	....
1950	7	....	129	174,609	...	.....	...	....	174,609	....
1951	10	27,440,866	135	175,755	3	.....	...	....	175,755	27,440,866
1952	13	33,532,810	145	195,803	5	232	...	....	195,803	33,533,042
1953	14	40,442,745	163	267,182	20	17,497	24	89,731,000	267,182	130,191,242
1954	19	47,631,411	174	326,106	25	26,939	28	100,166,664	326,106	147,825,014
1955	23	69,715,422	209	301,319	29	64,482	33	115,091,229	301,319	184,871,133
1956	23	121,869,721	221	430,447	37	92,124	47	188,455,411	433,850[1]	310,425,826[2]
1957	23	125,622,175	283	500,786	44	70,116	58	207,892,534	500,785[1]	333,584,825
Ten-year average, 1948-57	13	46,625,515	168	269,499	16	27,139	19	70,133,683	269,839	116,787,194

[1] Includes 5,903 Christmas trees cut on tree farm licences and farm wood-lots.
[2] Includes 8,570 cubic feet cut from Christmas-tree permits.

THE MINERAL INDUSTRY AND B.C.

Dr. Hartley Sargent *

THE PRESENT year is the 100th anniversary of the establishment of the mainland colony named British Columbia, in 1858. Administrative needs arising from a great rush for placer gold occasioned the establishment of the colony. The colony of Vancouver Island, created in 1849 continued its separate existence. The gold rush and its consequences resulted in the union of the two colonies in 1866, the extension of the area to that of the present province, and in 1871 the entrance of British Columbia into confederation as a province of the Dominion of Canada.

Before the gold rush, the area had a history of exploration and fur trade and on Vancouver Island and near Fort Langley of some agricultural and commercial developments. This background of experience in a rugged and difficult country cannot be overlooked in considering the era of expansion that began with the gold rush. The early history of these developments is reviewed on pages 00 to 00.

The Treaty of Washington, in 1846, settled the boundary as the 49th parallel on the mainland, thus giving to the United States much of the Columbia River including the part that had been most useful to the fur brigades. Although the right to navigate the river was preserved to the Hudson's Bay Company, that right was not exercised for long. War between the United States and the Indians in 1848 forced the Company to find an alternative route to its interior posts, and to transfer its main depot and headquarters to Victoria which had been established in 1843 in anticipation of the boundary settlement. The Fraser Canyon route between the newly established Fort Yale and the interior was attempted in 1848. Fort Yale was abandoned in 1849, and a less difficult route was adopted from Fort Hope through the Cascade Mountains to Fort Thompson (Kamloops). When thirst for placer gold brought thousands of eager adventurers into the area in 1858, knowledge won in 50 years of supplying interior trading posts was available to prospectors and administrators.

Lower Tunnel Georgia Mine, Rossland, B.C., before 1897.

*Chief of the Mineralogical Branch, British Columbia Department of Mines.

The twenty years preceding the gold rush saw the beginning of agriculture near Fort Langley and Victoria, the establishment of a fishing industry that shipped dried salmon up the coast and as far as the Hawaiian Islands, the beginning of coal mining* with shipments from Nanaimo to San Francisco and short lived efforts at lode-gold mining on Moresby Island in the Queen Charlotte Group. The development of commerce in the coastal area was in marked contrast with the activities in New Caledonia, where horse and canoe transportation limited activities to satisfying the most pressing needs of the fur trade, and serves to emphasize the importance of transportation then and now in British Columbia.

It is curious that in a period of some forty years in which much of the country had been traversed by fur traders no search seems to have been made for placer gold, and that within ten years of the gold rush in California, a gold rush was on in British Columbia. Possibly the recovery of a small quantity of gold on the Moresby Island in 1851, and the discovery of a small gold bearing vein there in 1852 drew attention to possibilities in British Columbia. Probably the first discovery of placer gold in British Columbia was made in 1855 on the Columbia River just north of the 49th parallel. In 1856 discoveries were reported near Fort Hope and on the Thompson River, and these precipitated the first and greatest gold rush. Because of increasing interest noted in placer gold in 1857, James Douglas, Governor of Vancouver Island and head of the Hudson's Bay Company on the Pacific Coast, anticipated a rush the following year, and assumed authority to regulate mining activities on the mainland. An inrush of gold seekers from Puget Sound began early in 1858. Others came by ship from California in thousands. By the end of July 15,000 people and perhaps some thousands more had entered the area in which the total white population had numbered a few hundred.

The gold seekers made their way from Esquimalt via Victoria to the mainland and up the Fraser River to Yale by boats they had built, or by ship as far as the river mouth, and by two American river boats authorized by Douglas to operate on the River.

After a disappointing period while workable gravels were limited by highwater, the bars exposed by falling water were worked and yielded fine gold in quantity sufficient to maintain interest and encourage search for other diggings. Bar after bar was found to pay and the miners pushed up the forbidding river at an amazing rate. The fact that some had

*Traffic in coal began in 1835, with coal recovered from the beach at Suquash on the northeast coast of Vancouver Island but it was not until 1852 at Nanaimo that a viable coal mining industry was established.

reached the Chilcotin River by July suggests that they had by-passed the canyons and reached the river upstream from the Thompson. By May 1859 the Quesnel River was reached and miners following up that river found it more rewarding than the Fraser. Keithley Creek, a tributary of the Quesnel, was found in 1860 and the search was carried over the divide and past the head of Cunningham Creek to Antler Creek. In 1861 Williams Creek, the most fabulous in the Cariboo, was discovered. The richness of that area caused a revival of the Cariboo rush, drawing miners from competing areas in British Columbia and from far parts of the world. Shallow diggings on upper Williams Creek were followed by deep diggings lower on the creek, the first successful shaft being sunk by Billy Barker for whom Barkerville was named.

We cannot trace the course of placer mining including frequent short lived booms or rushes in which easily won gold was worked out in many parts of the province, leaving deeper ground to be worked by those who could find the money necessary for costly hydraulic installations and poorer shallow ground to be worked by patient Chinese miners. In one hundred years placer mining has recovered gold valued at almost $96,000,000 of which almost a half was recovered in the first 25 years. Placer mining played a part in the development of British Columbia of which the importance cannot be approximated by taking the value of the gold recovered. In a year it increased the white population of British Columbia from a few hundred to more than 15,000 and in a few years forced the construction of roads and trails and on inland waters the construction of steamers, in feverish haste, in contrast with the leisurely fur trade that in 50 years had gained much knowledge of the country but had left it almost unchanged except for the establishment of scattered posts, and the beginnings of settlement on Vancouver Island and the lower Fraser.

Provincial Archives.

The Victoria shaft and ore bins of the Granby Company, Phoenix, (1907).

The hope of quick wealth and the high unit value of the product encouraged men to undertake placer mining in spite of the lack of transportation facilities necessary for almost any other activity. Consequently although many lode discoveries were made in the years following the early placer mining boom, substantial lode mining did not develop until facilities had been established to permit bringing in machinery required by mines and smelters to convey ore from the mines to smelters, to transport the necessary supplies, including coke required in large volume by the smelters and finally to ship matte or metal for further processing or to its ultimate market.

The Heinze Smelter on the Columbia River at Trail Creek (1896).

Provincial Archives.

Lode mining developed rapidly in the era of railway building and in turn stimulated the construction of branch railway lines. Kimberley, Nelson, Trail, Rossland, Grand Forks, Greenwood and small communities in the southern interior were established because of the opening of gold-copper, and silver-lead mines in the southern interior, and of smelters to treat their ores. The need of the smelters for coke and of the railroads for steam coal caused the opening of the Crowsnest Pass coalfield and the establishment of Fernie. Development of copper mines at Britannia, on Texada Island, Vancouver Island, and at Anyox, and the gold mines at Surf Inlet and Portland Canal followed the developments in the southern interior.

In the thirty years preceding World War I, lode metal production yielded gold, silver, copper, and lead in substantial volume; during the War production of zinc became important and subsequently other metals, either prime- or by-products, have been added to the list which also includes, or has included, iron, mercury, tungsten, antimony, bismuth, cadmium indium and tin. Much of the lead, zinc, silver, bismuth, and cadmium is refined at the Trail smelter of the Consolidated Mining and Smelting Company. Tin, copper, and iron, as ores and concentrates are exported to foreign smelters. Copper has been of great importance since early in the lode-mining history. Shutdowns in 1957 and early in 1958 have reduced the output of copper to the lowest level in sixty years. However, important supplies of copper ore have been indicated by work on recent discoveries and on deposits known for many years, and exploratory work is continuing.

Provincial Archives.

Placer miners on Williams Creek (1863).

Production of structural materials, mainly for the British Columbia market, includes,— cement, limestone, clay products, sand, gravel, and rock, with a combined value of more than $25,000,000 in 1957. The industrial minerals group includes half a dozen products but more than 85 per cent of the total value is in sulphur and asbestos. Until late in 1957 sulphur recovery was entirely a by-product of lode-metal mining. The sulphur has mainly been used in British Columbia in the production of fertilizer, chemical wood-pulp and in other chemical processes. Late in 1957 a large additional source of sulphur became available from the absorption plant at Taylor that removes sulphur from natural gas preparatory to shipment through the main pipeline. Asbestos production began in 1952 and reached a value of more than $9,000,000 for the year 1957. The asbestos comes from the McDame Creek area, not far from the Yukon boundary. Because of its high quality it commands a price that permits bearing the high transportation costs necessitated by the remote source and distant markets.

Coal production has been mainly from Vancouver Island and the Crowsnest Pass areas. The latter area, in the southeastern corner of the Province, has by far the largest deposits, and produces the best source of coking coal.

Monitors in a hydraulic placer pit, Atlin (1941).

B.C. Dept. of Mines.

Exploration continues to indicate increasing supplies of petroleum and natural gas in northeastern British Columbia. By the end of 1957, 22 oil wells and 130 gas wells had been completed. In the period 1942-1957 308 wells were drilled, of them 152 or almost 50 per cent, were completed as oil or gas wells.

Oil production began in 1956 and has gone to the X.L. Refinery of Dawson Creek. Gas production also began in 1956 to serve the village of Fort St. John. Construction of the Westcoast Transmission Company 30 inch pipeline to convey gas to southern British Columbia and to the international boundary was started late in 1955 and completed in 1957. The local gathering lines, and the absorption plant and sulphur recovery plant at Taylor came into use late in 1957. These facilities are now recovering liquid fractions and about 150 tons of sulphur a day in preparing gas. In British Columbia gas is supplied to the Vancouver area, Williams Lake, Kamloops, the Okanagan Valley, Trail and Nelson and also the Power Commission generating station at Prince George.

In 100 years British Columbia has produced minerals with a gross value of three billion nine hundred million dollars. By 1957 the list of products included a dozen metals, nine industrial minerals a dozen structural materials and three fuels. For the past ten years, the annual value has averaged $162,000,000 and it is apparent that despite reduced prices for important metals, and reduced output of several items, the accumulated gross value of mineral output will have passed the four billion dollar mark before the end of the centenary year.

HIGHWAYS IN BRITISH COLUMBIA

T. Miard M.E.I.C. Deputy Minister

BRITISH COLUMBIA has progressed far in its highway development since the day shortly after World War One, when an engineer said "We are now building roads 14 ft. wide—wide enough for this generation ,and the next!" Eight-lane divided highways are being designed and tenders will be called soon for the first stages of these multilane roads.

The Province has a difficult topography, in that it is crossed from north to south by all the mountain ranges of the Western Cordillera, while the majority of traffic wishes to move in an east and west direction. There are three main east-west routes. The Southern Trans Provincial Highway, which is close to the 49th parallel, and extends from Hope to the Crows Nest Pass. The Trans-Canada Highway which follows the Fraser River from Vancouver to Lytton, then east to Rogers Pass and the Kicking Horse Pass. The Northern Trans-Provincial Highway will cross the Province from Prince Rupert to Prince George, thence to McBride and the Yellowhead Pass.

A pioneer route from Kamloops up the North Thompson to the Yellowhead route is gradually being modernized.

The Province has a main north-south route, through the Okanagan to cross the Trans Canada at Kamloops, on to Cache Creek and north through the Cariboo to Prince George. The route continues north on the Hart Highway to join the Alaska Highway at Dawson Creek, and a new road is being constructed to replace the present route from Dawson Creek to the Alberta border.

This year Kitimat received its first road access and the first highway access to Squamish on Howe Sound was opened.

In the 1957-58 fiscal year, 247 miles of highway were constructed by contract and almost 24 million cubic yards of material were moved, including four million yards of rock. This was an increase over the previous year's total of 15.6 million, and the 6.7 million moved in 1955-56.

The B.C. Department of Highways, with headquarters at Victoria, divides the Province into four regions with a regional headquarters in each. These regions are divided into districts with thirty district offices. Duties are divided among the following headquarters' branches:

Location and design; construction (including paving); bridge; research and development (including traffic and testing); specifications and statistics; right-of-way; ferries; equipment; special projects.

The old Alexandria Suspension Bridge at Spuzzam.

Location and Design

The Location and Design Branch is responsible for reconnaissance, location survey and design for all major roads, and has done nearly all the Department's highway design, including major freeways under construction, or to be built in the immediate future.

It is interesting to note that in the last three or four years "800 miles" of topographic maps from aerial photographs have been used for location and design of highways. The larger portion of this mapping has been of the reconnaissance type with scales of 1″ = 1000′ or 1″ = 500′ with contour intervals at 20 ft. or 25 ft. A considerable amount of 1″ = 200′ and 1″ = 100′ 5-ft.-contour mapping has been used for location purposes. Fifty-eight miles of four-lane freeway have been designed on aerial mapping at a scale of 1″ = 100′ with 5-ft. contours, or 1″ = 50′ with 2-ft. contours. Considerable use is made of mosaics, photo lay-downs, and soils interpretation from aerial photos.

Construction and Paving

Thirty-four road contracts are in progress this year. At the end of the year, with the exception of 10 miles, the formidable Fraser Canyon will have been conquered by a Trans Canada standard highway. Of interest are two tunnels, 740 ft. and 950 ft. long, with an I.R. 17′1 from the springing line 8′9 above grade. They are lined with concrete and the roof sections are grouted.

The standard two-lane road section has a 24 ft. pavement with 10 ft. or 12 ft. shoulders.

One throughway currently being designed provides for an eight-lane divided roadway, while several sections of four-lane divided or separated highway are under construction.

On the Trans Canada the minimum thickness of base-course is 12 inches (6 in. of 2 in. crush and 6. in. of ¾ in. crush).

Paving is usually covered by a separate contract, but some current grading contracts require that the contractor pulvi-mix or road-mix the top of the base course, to prevent loss of gravel and to provide a smooth dust-free surface until paving is done.

The Department also operates two pulvi-mixing crews.

Paving on Trans Canada is designed to result in a 3-inch compacted thickness. On certain other highways a 2½-inch compacted pavement is laid.

The Department maintains a field laboratory on every paving project to design and control the mix, using the Marshall method.

The density is checked by core-drilling and this has resulted in extending the type of weather under which paving may be permitted. Satisfactory pavements have been obtained at temperatures as low as 26° F., and also in light rains.

Considerable success has been obtained with a new technique for seal-coating, using a lab design (based on the size of aggregate) for the amount of asphalt applied. A change in the gradation specifications permits adjustment for any size of aggregate.

Bridges

The topography of British Columbia produces turbulent and tremendous streams and rivers, and bridge crossings are a major problem.

A program was commenced about twelve years ago to replace all major bridges with permanent structures.

The Department, for economy purposes, uses a standard steel through truss for spans from 150 ft. to 250 ft. It also has standard steel beam concrete deck spans up to 70 ft in length.

The Department designed the first prestressed concrete bridge in Canada for the crossing of Mosquito Creek in North Vancouver. It also designed one of the first solid-slab post tensioned, prestressed, concrete spans for the Royal Avenue overpass in New Westminster.

Major bridges of interest in British Columbia include the Rock Creek Bridge, designed by the Department, a continuous cantilever of total length 938 ft., with the roadway 300 ft. above the creek.

The Agassiz-Rosedale Bridge, a major crossing of the Fraser, 6,127 ft. long, which cost 4.5 million dollars.

The Nine Mile Canyon Bridge, a 3-hinged arch of overall length 786 ft. with arch span 480 ft., height above the creek 360 ft.; opened 1958; cost 1.2 million dollars.

The Nelson Toll Bridge, designed by A. B. Sanderson Company, has a length of 2,062 ft., the two main piers being in water 80 ft. deep. The cost was 3.75 million dollars.

The Kelowna Toll Bridge, designed by Swan, Wooster and Partners, comprised of 2100 ft. of floating pontoon bridge, two articulated steel trusses 175 ft. long and a 260 ft. steel lift span; total length of approach causeways 1500 ft. The cost 7.3 million dollars.

The Hope-Princeton Highway, Skagit Bluffs.

The Oak Street Toll Bridge, designed by Phillips and Barratt, a four-lane high level roadway over the North Arm of the Fraser River, with connections at the south end to the Sea Island (Vancouver) Airport, and to the new freeway to the United States Border.

The Bridge Department has designed 10 ft. x 20 ft. rigid frame reinforced concrete culverts for use under deep fills 100 ft. or higher.

British Columbia is a Province of forests, and treated timber is being used for bridges built on secondary roads. Pioneering is being done on glulam construction.

Deas Island Tunnel

The outstanding feat in highway work in British Columbia this year is the construction of the Deas Tunnel, a 4-lane traffic artery under the south or main ship channel of the Fraser River.

Six reinforced concrete tunnel elements, each 344 ft. long, 78 ft. wide and 24 ft. high were constructed in a drydock, sealed and floated out, and lowered into a dredged trench.

The ramp to ramp length is 4,360 feet and the portal to portal distance 2,155 ft.

Ferries

Due to the number of large rivers and lakes, on many highways it has been necessary to carry traffic over the water by ferry. Many of the Coastal Islands, particularly in the Gulf of Georgia, are attractive residential and resort areas, and traffic is ferried to most of them.

Many of the operations are extensive. The ferry across Okanagan Lake, which was replaced by a mile-long causeway and bridge on July 19th, operated three ferries continuously of 30-38 car capacity.

The largest Government-owned ferry is the M. V. *Anscomb*, which carries forty cars on its 5½ mile run across Kootenay Lake. It is a conventional ferry, while its sister-ship the 36-car M.V. *Balfour* is a barge-type, powered by "outboard" type motors.

On the inland lakes and rivers, the Department operates seven Government-owned toll ferries, 33 free ferries, two chartered ferries, and one aerial ferry to carry cars across the Fraser Canyon at North Bay. On salt water, eight out of nine ferries operated are chartered.

The Toll authority has called for tenders for two sea-going ferries to operate between the Saanish Peninsula on Vancouver Island and the

Mainland. Each will carry 108 cars, and will be 330 ft. long with a 74 ft. beam and will be propelled by two 3,000 b.h.p. engines at 18 knots.

Materials Testing

The Testing Branch has advanced from its origin in 1948 to become a large and important factor in the Department. Its functions include soil analysis, materials testing, design of road subgrade, design of pavement thickness, control of land slides, which are large and numerous in both the mountainous and flat areas, deep soil investigation, establishing the bearing capacity of soils for bridge foundations, design of concrete mixes, interpretation of aerial photos, interpretation of geological investigations and investigation of granular deposits.

Current research on pavement includes Benkelman beam tests at all seasons, plate bearing, soil and pavement tests.

Temperature and moisture profiles are being studied to investigate the relationship of soil type, moisture, frost penetrations, and spring thaw loss of bearing strength.

The southern part of the Province is predominantly granular, and glacial tills; the central part is lake silts and varved clays, while the northern part is heavy clays.

Problems arise with slides, soft subgrades not preconsolidated, and extremely low strength silts. Some bridge foundations are difficult, due to the great depths of soft clays in the Fraser Valley and the western fiords.

Most of the gravels are excellent, except in the northern part of the Province where lake deposits have covered natural ones and where, ironically, gravel is most needed.

Traffic Branch

The Traffic Branch directs all traffic, origin and destination surveys; predicts traffic requirements, assists in design of freeways, designs and directs all traffic control devices and intersection illumination. It operates 13 permanent weigh scales (four continuously) and two roving scale patrols, bridge traffic patrols, the Department sign shop and the striping units.

The senior traffic engineer acts on planning committees and safety committees.

Right-of-Way

The Department's Right-of-Way Branch assesses all properties required, makes title searches, negotiates the purchase and arranges disposal of surplus property. Formerly, right-of-way purchases were a small portion of a

Road construction near Alexandria Bridge (October 1957).

project cost, but in the case of freeways in the rich farmlands of the Fraser Delta, and in urban residential, commercial and industrial land, the cost of right-of-way may amount to 40% of the grading cost.

Classification of Roads

A large part of British Columbia is unorganized, and there the Department of Highways is responsible for all roads and streets, including construction and maintenance.

In the Municipalities, with the exception of the Cities of Vancouver, Victoria and New Westminster, through provincial highways are classified as arterial, and the Department assumes the full cost of them from curb to curb. Certain other through roads, or by-passes, may be classified as secondary. These are operated by the Municipality, but the Province pays 50% of construction costs and 40% of maintenance costs on a preapproved budget.

Maintenance

Maintenance is a continuing chore in British Columbia. The heavy rains are damaging to gravel road surfaces, and to shoulders and slopes of all roads. Extreme runoffs on the coast in the fall, and in the interior in the spring, require constant protection of roads and bridges. Severe frost and icing conditions, and heavy snowfalls require expenditures for snow removal and sanding as high as 3.5 million dollars in a single winter season.

The district crews are well equipped for both summer and winter maintenance, and for construction undertaken on a day-labour basis. Since the war, 4110 miles of road have been constructed or improved by District Forces.

The inventory includes 59 large tractors (D7 and larger); 83 small tractors; 61 tractor loaders; 53 power shovels; 614 dump trucks; 255 power graders; 170 sanders; 9 rotary tractor-mounted snow-plows and 12 snow plow trucks (plows are available for most of the larger trucks also); 39 tar kettles; 9 pulvi-mixers; 48 rollers; and 7 gravel-crushing plants.

Conclusion

Traffic is continually increasing in British Columbia. The motor vehicle registration has more than tripled since 1946, when 147,196 autos and commercial vehicles were listed. On January 31st, 1958, this figure had grown to 478,490.

The Pattullo Bridge (a 4-lane structure carrying the present Trans-Canada traffic into New Westminster) has recorded a volume of 53,983 for one day, with hourly volumes in one direction of 2700.

New areas are being developed, such as Kitimat, and the far north. Routes into Vancouver are becoming congested. The incidence of heavy axle loads is mounting. A continuing but rewarding task faces British Columbia's highway builders.

Summary of British Columbia Highways 31st July, 1958

	miles
Paved	3,520
Surface-treated	176
Base-processed	143
Gravelled	9,842
Dirt	7,653
Undeveloped, or cleared only	1,670
Total	23,004

PLANNING

THE KEY TO FUTURE POWER DEVELOPMENT

BRITISH Columbia's electrical power requirements today (July, 1958) are a little over 2 million kilowatts. Fifty years from now they will be close to 50 million.

British Columbia grew during the century following the advent of those who came to seek their individual fortunes. Many of them remained, pooled their resources and formed communities. These communities needed energy on a basis much larger than that of the prospector. Not until recent years has much thought been given to looking more than a few years into the future to see what energy needs might be.

The next 50 years will be within the life span of many of today's younger generation, who will be able to see the progress of long-range planning—that is, if long-range planning is adopted.

This sort of planning was actually started 15 years ago. The government set up a Rural Electrification Committee in 1943 to "report upon the extent and condition of electrical service in the Province of British Columbia with particular reference to the service in rural communities." Its findings include the following[1]:

> There is a close inter-dependent relationship between rural electrification and the central station industry established to supply cities, towns and villages.
>
> The large number of small separate organizations supplying electricity in the Province is a serious obstacle to a sound industry and extension of service.
>
> In the opinion of the Committee, a major reorganization of the central station industry is necessary not only that service may be extended in the rural areas but also that rates and service in towns, villages, and areas at present served may be improved.
>
> In the reorganization as many as possible of the present supply systems should be combined under one control which should have sufficient capital to carry out an extensive construction programme and to carry on the operation of the combined systems until they become self-sustaining.

These recommendations were without limitation, as was also the legislation which was enacted to put them into effect.

The intent of this report has been carried out under the Power Act, administered by the British Columbia Power Commission, by extending electrical service throughout the towns, villages and sparsely settled areas of the province, outside the metropolitan areas.

Now is the time to plan for B.C.'s growing requirements for electrical energy by extending the plan, which has already proved so successful.

Future Power Requirements

Figure 1 shows the province's estimated power requirements over the next 50 years—1958 to 2008.

The curve on the chart is based on an increase in demand of 6 per cent compounded annually with a base figure at the year 1975 somewhat lower than the province's estimate as submitted to the Royal Commission on Canada's Economic Prospects.

For the past several years, B.C.'s annual rate of growth in electric power requirements has averaged about 13 per cent, well above the national average of about 7 per cent. It is not expected that the rate of increase of 13 per cent will be sustained.

The 6 per cent rate is quite conservative compared to world averages. In the Gordon Commission's report "Canada's Energy Prospects," Dr. John Davis commented that[2]:

> In most countries (and regardless of their degree of industrialization) the demand for electricity will continue to rise at a long-run average rate approximating 7 per cent per annum; there is no statistical basis for the contention that, as power consumption increases, the rate at which it does so tends to decline.

Dr. Davis also said that the annual rates of growth in demand do not differ markedly between the economies which are now beginning and those, like Norway and Canada, which already use electricity intensively. In other words, we can expect our use of electricity to continue rising to match the trend of rising living standards and further advances in automation.

An official of the Tennessee Valley Authority recently said that average residential use, now 6,500 kwh. per year (almost double the Canadian average), may be 40,000 kwh. per year 25 years from now. This means that one would use as much electricity in a month as now in a year.

World consumption of primary energy has increased recently by 2½ per cent a year, while the consumption of electricity has increased by over 8 per cent a year.[3] Primary energy means the result of the first conversion of a raw material or resource into a form that can be employed in doing useful work. Examples are the conversion of water power into electricity, coal into steam, natural gas or oil into the mechanical force of a reciprocating engine. And so half the primary energy may be utilized as electricity by 1975. What may it be by the year 2008?

In Canada, electricity accounted for 15 per cent of total energy consumption in 1926; it was 24 per cent in 1955.[2] This trend would have been higher but for the huge energy source in Canada's oil and natural gas. The oil and gas industries have moved into the field of basic energy supply, and also provided raw materials for the multiplicity of synthetics, such as nylon and plastics. In the next century, people may say ". . . in the last century they actually used to burn oil.[4]"

Oil will continue to be faced with increasing demands, particularly in transportation. Perhaps before long the world will welcome the replacement of some of the uses for oil by nuclear energy, so that oil, a depleting resource, may assume a greater role as a source of raw materials.

Population

Increase in population alone is an important factor in the future growth and demand for electricity. Figure 2 is the curve of population in British Columbia projected to the year 2008. This was based partly on the prediction made for the Gordon Commission, but more directly on a study made by the B.C. Research Council[5] in which B.C.'s population was estimated to 1975.

The rate of increase in B.C. has been higher than for each of the other provinces and is assumed to continue so, even after 1975, at a rate slightly

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Based on an address by C. W. Nash, M.E.I.C., Director of Load Development, B.C. Power Commission, to Hope and District Board of Trade, July, 1958 under 3 per cent per annum. This should be reasonable, keeping in mind undeveloped potential in raw materials, energy resources, seaports for rail and water trade, and the fact that B.C. is one part of the world that is becoming more and more attractive to live in. Some hold the opinion that the rate of population increase, and also the rate of increase in electrical demand, will share a marked decline after the next 20 or 30 years. This is unlikely in B.C. and there is every reason to assume that the growth of population in this province will reach a total of 8½ million persons by the end of the next half century.

This expanding population will continually increase the domestic market at the same time as we endeavour to improve our competitive position in world markets.

Per capita use of electricity

Figure 3 shows the relationship between the demand for electricity and population. Dividing one into the other gives the future trend of electricity demand *per capita.* This indicates an average demand of 5.6 kilowatts *per capita* by the end of this half century.

There are other ways of estimating this figure, but this gives us a comparison with estimates made by others. The Hydro-Electric Power Commission of Ontario made estimates of *per capita* increase of electrical demand for the Gordon Commission in 1956.[6] The results ranged from a long-term rate of growth of 4.85 per cent, based on population and capital projections, to zero, based on an assumption that there might be no future growth at all. The figure 4.85 per cent growth rate, presented in Ontario Hydro's graphic illustration, is the figure to be compared with the mean growth rate indicated by Fig. 3 (something less than 2½ per cent).

This comparison shows no extravagance in our estimate of future demands, rather, a possible underestimate.

Sources of Power Supply

Whatever the load growth, it must be met by some method or combination of methods. No one plan can be formulated now and be expected to hold good over the next century. But plans must be formulated on a long-range basis in the light of today's conditions and tomorrow's forecasts. They can then be continually brought up to date on actual experience.

How demand will be met depends upon the type of loads on the line, and on their individual and group characteristics. These include daily and annual load factors and the effects of different loads on system diversity. For example, a sawmill operating three shifts a day with a certain maximum load has three times as high a load factor as when it operates only one shift with the same maximum load. A pulp mill, or electrochemical plant which operates continuously seven days a week, has a much higher load factor than a sawmill. Diversity is the effect of a mill's maximum electrical demand being considerably less than the arithmetic sum of all the individual motor loads, because they are not all fully on the same time.

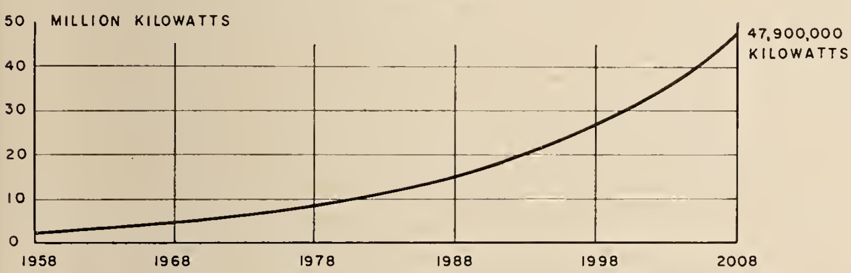
These factors, collectively, influence the type of operation of the generating plants supplying the load or system, and hence influence the selection of the type of power plant.

The types of power which may be employed to meet the growth are hydro, thermal (that is, the use of fuel such as coal, oil or gas to produce heat), or nuclear. As well as load factor and diversity, other factors influencing the selection of one or other, or all of these types are: capital cost, fuel cost, heat rate, transmission cost. The energy picture is essentially dynamic, varying constantly with time and economics. In one locality a hydro plant may be the best selection to supply a load, whereas in another a thermal plant may be the best choice to serve exactly the same kind of load.

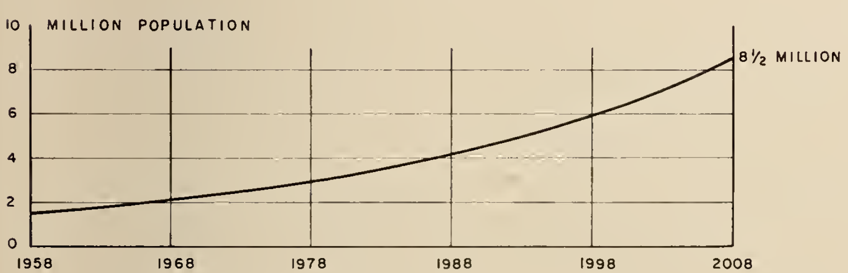
In other words, no single, all-embracive formula can be established. Power systems must be tailor-made and custom-built.

The best overall answer is the system that will provide the greatest benefit to the most people for the longest time. The relative importance of the various means of generating power in B.C. is indicated by Table I, which shows recent proportions between hydro and thermal energy.

Top to bottom: Fig. 1, 2, 3.



50 YEAR FORECASTED GROWTH IN B.C.'s ELECTRICAL DEMAND



50 YEAR FORECASTED GROWTH IN B.C.'s POPULATION

50 YEAR FORECASTED INCREASE IN
B.C.'s ELECTRICAL CAPACITY REQUIREMENTS PER CAPITA

Table I.
Energy Generated in Canada and B.C., 1956-7
(in kwh x 1000)

	Canada kwh	% Total Energy	British Columbia kwh	% Total Energy
Hydro	81,408,254	92.6	9,350,558	92.9
Thermal	6,530,677	7.4	719,778	7.1

Thermal

Coal is not a major source of energy in B.C., accounting for only about 15 per cent based on conversion to merchanical energy, and half that used is imported.[8] The railroads indicate the principal means if transportation which becomes a real factor in the delivered cost of fuel, if it is to be used in power plants remote from the coal fields. Consequently, transportation affects the final price of electrical energy. A coal-fired steam plant's economy is usually best when the plant can be situated right in the coal field and the coal can be mined at a low cost. The future of coal-produced power will depend on relative costs of alternative sources, and on the feasibility of power transfer by transmission line compared to coal transfer by rail.

A coal-fired power station depends upon the ability of utilities on industries to obtain coal supplies throughout the useful life of the plant at costs close to those which are at present operative. The problem of supplying large volumes of fuel is staggering when compared to present production. For example, to supply fuel to a 500,000 kilowatt generating station, coal output in the province would have to be doubled, added to which is the long-term upward trend in fuel prices. Since coal costs at load centres make competition with hydro and gas difficult today, one cannot expect coal to play a major part in power production in British Columbia in the future.

Sources of gas and oil are not great in B.C. itself although proven reserves are increasing. Unfortunately, most of them are in the far north-east corner of the province. The pipeline is the principal means of transporting both these types of energy from their sources to the load centres. A pipeline has a high capital cost and must be operated at high load factor to be economical.

Several small power generating stations are now operating on gas from the pipeline system, and a large station of 900,000 kilowatt capacity is now under construction on the lower mainland. This is expected to use 144 million cubic feet of natural gas a day at 70 per cent load factor.

If a subsequent gas-fuelled generating station were planned at a capacity of, say, 500,000 kilowatts, another 80 million cubic feet of gas per day would be required. This amount of gas could not be supplied from domestic sources without a second pipeline. Its effect on cost is easy to see.

It is unlikely that a new pipeline could be built for the same unit cost as the present one. The rise in labour and material costs would rule otherwise. Costs of drilling for new gas reserves are going up and the contracts for supply to the pipeline are likely to be at higher prices than those in the past. This is a case where large consumption is more expensive than small consumption because of the additional collecting systems required to gather the gas to the point of delivery to the pipeline.[9]

Therefore, we must expect future gas contracts to be at higher prices than those at present, with the result that the cost of the electrical output of gas-fuelled generating plants must rise. In point of fact, it is historically true that the cost trend of thermal fuels always rises; it does not go down.

On the other hand, continued improvements in thermal efficiency will offset the rapid increases in fuel costs which appear certain to take place in the next decade. Such improvements, however, are becoming more difficult to attain, both technically and economically. There are many indications that advances in technology are tending to lag behind the present inflation of costs of labour and materials.[10] But costs must be competitive to start with and this is difficult unless a generating plant can be located at a coal field or near the source of oil or gas. This is not usually near the load centre, particularly in British Columbia today, and present favourable gas contracts are not likely to be duplicated in the future.

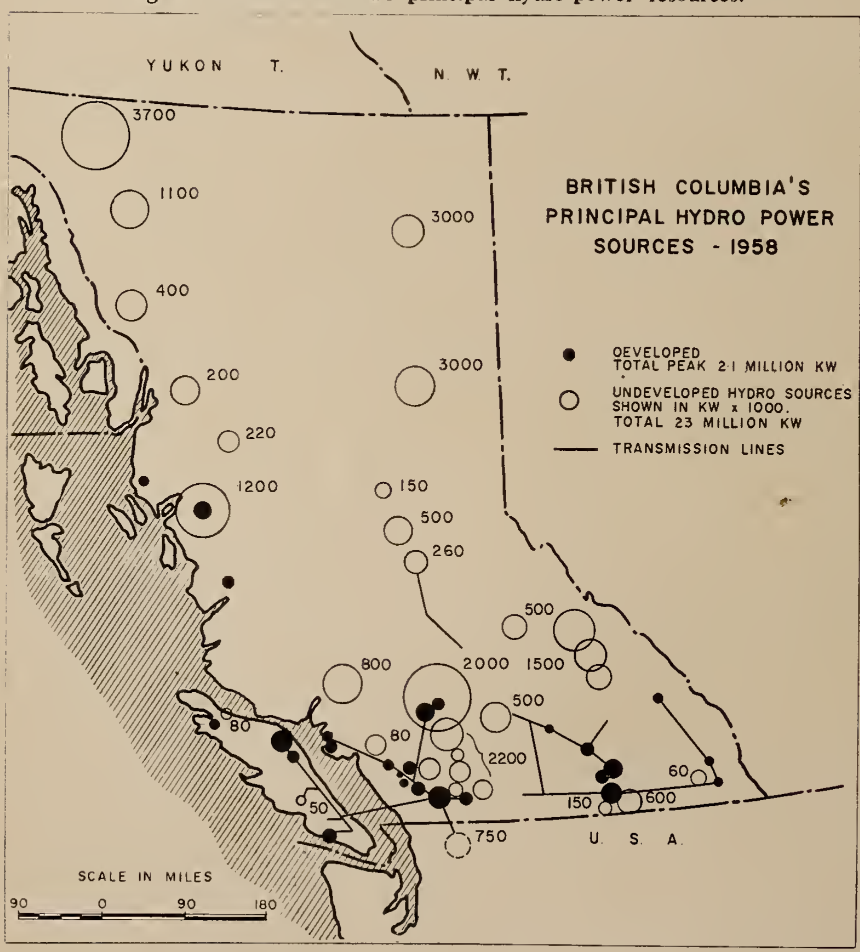
Hydro

B.C.'s principal hydro resources are shown on Fig. 4. The building of large thermal plants on both the mainland and Vancouver Island may appear to indicate that we have run out of hydro already, and yet the undeveloped capacity totals some 23 million kilowatts compared to a little over 2 million developed today (in round figures).

Figures could vary depending upon the type of power developed — whether for base load or peaking operation.

The unsolved problems of the coexistence of fish and dams have delayed a number of hydro projects capable of producing low-cost power. The unresolved international problems on the Columbia River have so far precluded the development of

Fig. 4. British Columbia's principal hydro-power resources.



power in Canada and the division of downstream benefits between ourselves and the United States.

But these are not the only reasons for delay. If, instead of various areas of the province being under different authorities for power supply, there had been overall integrated system planning and control during past years, the present situation could have been quite different. It might not have been necessary to build large gas-burning generating plants on the mainland and an oil-burning plant on the Island —while large hydro sources still await markets and development.

The very large hydro potentials in the northern part of the province are not yet developed because the market is not there. As long as the load centres are in the southern part, the economics of power transmission rule against the northern developments in the near future, particularly as long as hydro power is available closer to the load.

Even if there were no more hydro potential in this lower part of B.C., it is unlikely that transmission of power from the far northern sources could compete with thermal generated power today, or perhaps even with nuclear power 20 years from now. However, one must assume that the demand for that northern power will exist, and that it will be developed for use in the northern regions, or for transmission south, or both, according to the economics of power supply at the time.

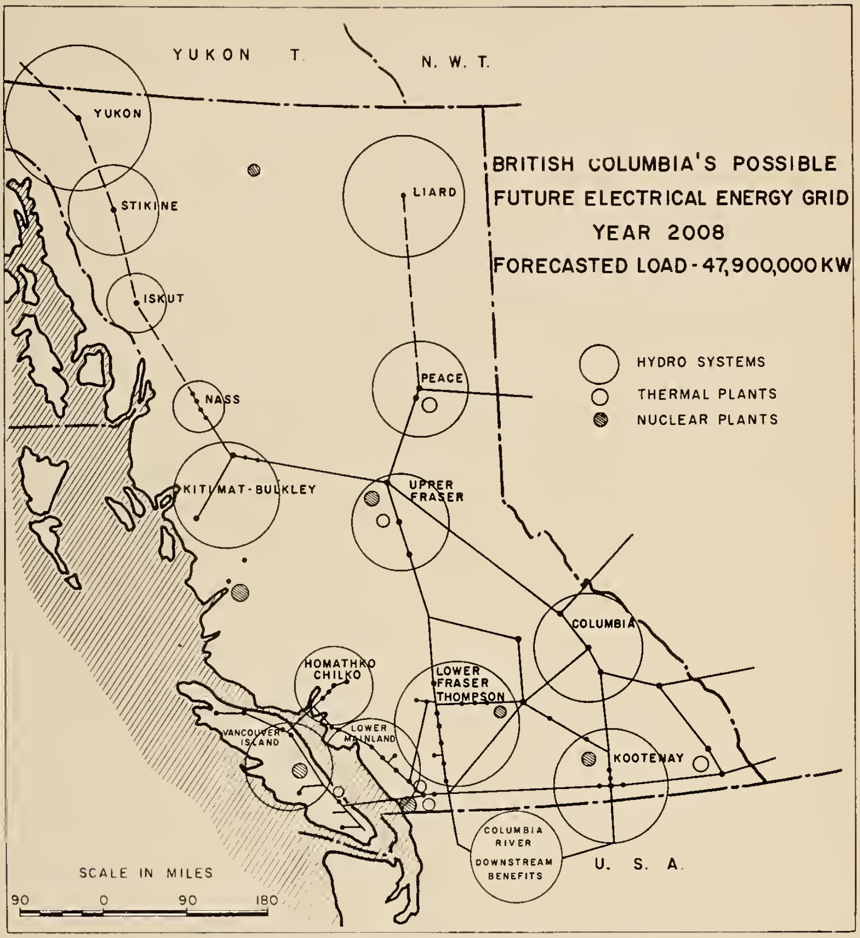


Fig. 5. Possible future electrical energy grid.

Nuclear

What will be the role of nuclear power in British Columbia? B.C. should be the last province in Canada to develop nuclear power on a large scale.

Nuclear plants should be operated on base load because of high capital cost. Nuclear plants are not adaptable to quick on and off operation for peak loads. Only large-scale plants can be expected to reach a unit cost level competitive with conventional types of thermal power, and then only after much more development work over a period of years.

A large nuclear plant should be installed only on a large integrated system where the capacity of the plant will be a relatively small percentage of total load. At the present stage of development, nuclear plants are faced with operating difficulties resulting in extended shutdowns for one reason or another. A large utility system could not chop off a portion of its otherwise continuous power supply while waiting for radioactive dust to be mopped up in a shutdown plant, unless its capacity could be picked up by other plants on the transmission network.

The cost of nuclear produced power is not expected to be competitive with hydro or conventional thermal power in British Columbia for many years yet. Britain is planning large nuclear installations because of the scarcity and high cost of other types of power. A cost equivalent of about 12 mills per kilowatthour may be competitive in Britain, but it certainly isn't here. Also, the planned installations are a much

Fig. 6. Earliest of B.C.'s large hydro developments was the West Kootenay Light and Power Company plant at Lower Connington, built in 1897. (Provincial Archives)

Fig. 7. Strathcona development of the B.C. Power Commission is the third dam and generating station on Campbell River system, central Vancouver Island. White arrow shows semi-outdoor type station; black arrow shows gate structure on spillway.

smaller percentage of the total load on the British transmission grid than they would be in British Columbia where we have not yet got a grid.

From this, it appears that nuclear plants should first become of value in supplying large quantities of electricity to meet the base load of a large transmission network. They are not immediately suited to the needs of small networks or to intermittent loads.[11]

Application of Sources to Meet the Demand

The long-range problem is to meet the demand for electricity from available sources to obtain the best results. The important thing is that all sources be considered in the light of long-range planning for optimum benefit. Such planning must take into account all energy sources, the economics of their conversion into electricity, the transportation of fuel or transmission of power, and the relation of power to other resources.

Over the next 50 years, additions will be made to power supplies until the province is served by a high voltage transmission grid that may look something like Fig. 5. The map shows the power system as it might look in the year 2008.

All the principal hydro sources would have been developed, and those in the southern two-thirds of the province at least would have been joined by a network of high-voltage transmission lines. If planning and its implementation are to be effective, it is obvious that future main transmission lines should be designed and built for the high voltages (in some cases, probably 500,000 volts) that will be required for future operation on an integrated system.

The large sources in the northern regions may or may not be physically joined, depending upon markets and the economics of transmission. There are still many problems to be solved before long-distance power transmission becomes practical. These include the electrical stability and the physical reliability of a long line, and the economics of transmission cost related to power delivered. Dotted lines are drawn on the map to the Yukon, Liard, Stikine and other northern sources because of their remoteness, and to indicate that it is possible that these might first be developed as power sources for heavy electricity-consuming industries. Any acceleration of growth in these areas, however, could materially alter the schedule of additions as shown.

Thermal plants are shown. These may have been on the system for some years, going through the transition to nuclear supply. They may still be operating on the fossil fuels of coal, oil or gas, according to their function for base load, peaking, or stand-by supply, according to the economics of fuel supply, and to the relative efficiency and reliability of nuclear power.

Indicated are nuclear plants introduced at major load centres such as Vancouver, Kamloops, Trail, Prince George, Nanaimo, to carry the base load on the network. The already existing hydro plants may then be converted progressively from base load to peaking operation. The full, system-wide advantages of this will be possible, of course, only if the hydro resources have been developed according to plan.

Peaking Capacity

Consider what this means. Take, for example, a hydro plant designed and built for base load operation. It must average out the minimum and maximum water flows of the river by storage dams and control works so as to produce a constant amount of power throughout the year. Its generating capacity is matched to that constant average. If a nuclear source takes over the base load, the hydro plant's generating capacity can then be upgraded for use as a peaking plant. This means that it can take care of the fluctuations in the hour to hour, or season to season demand by the installation of additional generators, using the same amount of water over shorter periods. There may be little or no additional investment in storage or control works. Thus the unit cost per kilowatt of hydro capacity can be materially reduced. To put it another way, the value of hydro power on a transmission system will increase when nuclear power can handle base loads economically.

If the John Hart Plant on the Campbell River, for example, can be regarded as having a capacity of 120,000 kilowatts for base load operation, it could produce 200,000 kilowatts or more as a peaking plant. This would be accomplished by a greater capacity in generators operating for a few hours at a time to handle the peak loads. Apply this same principle to the province's future hydro potential of 23 million kilowatts and, depending upon design load factor, the capacity could be upgraded to 30, or perhaps 40 million kilowatts for peaking purposes as nuclear power moves in on the base load.

The best economic advantage of this feature will be obtained by the construction of hydro plants at the earliest date consistent with system requirements. The earlier the development, the lower the unit cost on a rising trend of construction costs.

One or two nuclear plants are shown not connected to the network to illustrate the possible economic use of small-scale, higher-cost nuclear plants in isolated, industrial centres such as Ocean Falls or Cassiar. These are used for illustration only, but are the sort of places where nuclear supply may be economically feasible sooner than elsewhere because of the cost of other fuels or of power transmission.

Development of Conflicting Resources

Comprehensive development must take into account resources whose interests conflict. If problems of fish and power can be solved by the decade 1968-78, then the Fraser may be developed for joint resource use. If they still are unsolved it may be necessary to compromise by building the Moran Dam sometime during 1968-78. This would affect only a minor portion of B.C.'s salmon production. Development of the Lower Fraser and the Thompson could then be deferred until the next decade.

If it were still impossible to develop the Lower Fraser and Thompson in order to take advantage of some of the cheapest power sources in the country, the schedule would involve a large increase in thermal or nuclear supply.

It is heartening to note a new desire on both sides of the fish and power question to co-operate in research to achieve the best results in joint resource use.

There are other factors besides fish and power affecting your hydro resources. Great importance should be attached to problems of flood control, navigation, erosion, irrigation, pollution, and just ordinary water supply.

Islands have been cut in half and carried downstream as silt by unregulated river flow. Timber purchased by lumber companies has become a dead loss when it was uprooted by the Fraser. Farmland has disappeared and roads have been washed away. Sand bars have built up in the navigation channel of a relatively new bridge and the river is moving closer each year to the approach foundations. One third of the tax bill in some areas goes for nothing more than to keep the river out of the streets and basements.

If co-ordinated and comprehensive resource development would solve many problems on one river, consider the advantages of one authority to deal with power matters on all hydro resources.

Output to be Matched to Demand

The scheduling of additional sources of supply will depend to a large extent on how plant output can be matched to market demand. This matching must be in both quantity and price.

B.C. is now at the stage of its development when it needs low-cost power. Small projects are expensive; large projects have capacity that will not be used all at once. The large ones may be developed in stages with regard to generating capacity, but heavy initial investment may be required for storage dams and other works that are common to the complete development. It may take some years before the total output of a large project is needed by the B.C. power market, because the capacity of the project may be a very large percentage of the capacity installed in B.C. today. This will not be the case a few decades from now when a one million kilowatt addition may be sufficient to meet only about one year's growth.

This suggests that planning takes into consideration financing, marketing and authority.

Financing

An offer of federal assistance in financing has already been made. The availability of low-interest money is an important factor in resource development involving investments that are large in proportion to present population and demand, but which are perfectly reasonable in the light of anticipated growth.

The cost of money alone can represent more than half of the final marketing price of the power. Electric utility investment is high per unit of power or per customer; the ability to finance at as low an interest rate as possible is, therefore, significant.

Marketing

The initial marketing of the output of a large project must be part of the planning. In an economy where power demand is growing, additional capacity must always be installed somewhat in excess of immediate demand. Small projects are relatively expensive, and desirable, large, low unit cost projects may have surplus capacity for some years before being fully utilized. Revenues are needed as soon as the investment is made in order to discharge debt obligations.

Two sources of revenue are possible apart from the already established and growing demand. One is from large power consuming industries, and the other is from temporary, recoverable export. Both of these have their problems.

Industrial Sales

There are a few industries to whom electrical energy at low price is important. It is regarded almost as a raw material. The availability of such power can be a major factor in influencing the location of these industries. It might be thought wise to offer a block of power that would otherwise be surplus to initial requirements at a low price to induce establishment of load and bring in immediate revenue.

Planning must take this into account because the overall benefit to the country's economy of a large consumer of low-priced power that employs relatively few persons is sometimes debatable. If this power is in an area that is growing and that will need it for expansion within a comparatively short period, then the wisdom of such disposals of power should be carefully considered.

This is no problem in remote locations where the power potential may not become a factor on a transmission grid for many years. Alcan, at Kitimat, is an example. Even this power source may some day become part of a provincial grid.

Export of Power

The other means of disposing of initial surplus is, of course, by export contract. It must immediately be recognized that any surplus capacity is only temporary. This country will eventually need all the power that can be produced. Therefore, any contract made with another country must be safeguarded to allow the recovery by B.C. of its power output when needed.

The development of large-scale projects would be facilitated by assured revenues during the initial years of operation if satisfactory export contracts were possible. This is still an unresolved question. The problem is to write an export contract to ensure that the purchaser makes adequate arrangements to supply his own growing loads when the supplier needs the power.

The future will emphasize more than ever that energy is interprovincial and international, that energy agreements must transcend political boundaries.

(References on page 73)

INDUSTRY

COMMUNICATIONS - COMMERCE

THE ECONOMY of British Columbia has largely been dependent on the natural resources of the province, particularly in the field of wood products. For example, statistics for the value of manufacturing production by industrial groups for the year 1956 show that the value of wood products and paper products accounted for some 43.5 per cent of shipments worth nearly $1,905 million. However, in recent years there has been a tendency to greater diversification of industry, not unaccompanied by various labour problems.

Backing all this development of industry there is naturally a considerable growth in the supply of electrical and thermal energy. Current developments in the production of electrical energy have been discussed in the October issue of the *Engineering Journal*, and the planning of future requirements is dealt with in an article on page 64 of this issue. Although British Columbia has some indigenous resources of coal, petroleum, and natural gas, and considerable effort is being made to find more of these resources within the province, far more of these thermal fuels are available in the neighbouring province of Alberta. Whatever the original source, transport by rail, road, and pipeline has to be developed to meet the needs of industry.

Natural Gas

The distribution of natural gas has in itself become a major industry. The largest undertaking has been that of the Westcoast Transmission Company Limited with the installation of a 30-inch pipeline to serve the interior and lower mainland areas of British Columbia as well as the northwestern part of the United States. Initial capacity of the pipeline was 400 million cubic feet of gas a day, but this was to be expanded to a throughput of 660 million cu. ft. a day by the addition of a booster pumping station at a cost of an additional $70 million above the original $155 million invested in the project. Further expansions are under way.

New Products

Among the recent new products and industries are aluminum (the Kitimat development), asbestos, and the aforementioned natural gas. Shipyards, iron and steel processing, food and other consumer goods producers have all been active.

Capital investment in industrial projects has been exceptionally high in recent years, and the industrial and commercial construction fields have been correspondingly vigorous.

Nearly 1500-million dollars of private and public capital were invested during 1957. Much of this expenditure went into engineering construction, particularly into the fields of electrical power, thermal fuels, and highway construction.

Labour Problems

A prominent member of the construction industry in British Columbia, who is also associated with national construction interests, has recently expressed concern about the labour situation in the province. Some of his views are quoted here.

The construction industry, which is basic to the establishment or expansion of all other industries, serves as a good illustration of the difficulties encountered. Largely because of a crash programme during recent years, abuses by management and labour became quite common. This was greatly aggravated by a few large contractors coming in from the outside, unaware and totally unappreciative of local B.C. conditions. Such contractors, operating on huge budgets and unlimited financing, gave concessions in wages, fringe benefits and working conditions, without regard for the effect such "give-aways" would have on local economy. To justify their position, they would say that in view of the huge sums of money required to finance the particular project (none of which would be productive until the plant actually started producing) it was far better to give way on such matters as unrealistic wages and working conditions than to face high interest charges for long periods of time if completion of the project were delayed by manpower shortages and/or industrial disputes. The result of such thinking is now all too apparent. Even union representatives admit that some of the concessions given were far out of line with the economy. However, such wages and conditions were used at the bargaining table as "established practices", and consequently local contractors were forced to negotiate on such a basis.

British Columbia has long enjoyed two outstanding natural advantages for industrial development, an adequate supply of hydro-electric power and ready access to tidewater and competitive shipping rates. In view of recent nation-wide developments, these factors should be re-assessed. The construction and operation of Trans-Canada Pipe Lines, for instance, puts huge power potential into areas which have never previously enjoyed such prospects. The power transmitted by this organization is available to investors without the necessity of building expensive hydro projects, a gas trunk line being relatively inexpensive to construct and maintain. Again, there is the effect on world shipping lanes of the St. Lawrence seaway project. More than one-third of Canada will literally be at or near deep-sea shipping, with all the implications that such a low-cost form of transportation carries. To say that industry *must* come to British Columbia is to cherish a myth, and investors are showing just how big a myth such thinking implies. Alberta changed its economy almost overnight from agricultural to industrial, Saskatchewan is fast following suit, and Manitoba can be expected to do likewise.

Speaking of major problems in British Columbia, it is pointed out that fringe benefits must be re-examined, productivity must be re-established, and there must be an immediate end to the wildcat walk-outs and jurisdictional disputes which have disrupted the construction industry in B.C. for the past few years. It is stated that the unions will oppose any move to reduce their "hard-won gains", but they are also going to have to consider whether it is really to their advantage to have the highest wages and best conditions embodied in their union agreements, with no one working to enjoy them. Management must become more cost-conscious, re-assert its authority, and strive for greater efficiency at all levels.

While the consumer price index increased 66.8% during the period 1945 to 1958, the lowest wage increase in the basic building trades was 126.9%, and the highest was 174.7%. Again, while the consumer price index increased 25.1% during the period 1949-58, the lowest wage increase in these particular trades over the same period was 63.6% and the highest was 77.3%.

In the case of operating engineers and teamsters, where no full degree of organization was experienced previous to 1951, figures for the period 1951 to 1958 indicate that, while during this period the consumer price index increased 10%, wage increases in the various categories involved were all in excess of 63%.

Taking into consideration fringe benefits, which range from a basic minimum of 25c per hour to over $1.00 per hour, the figures for percentage wage increases would be much higher.

British Columbia is the only province in Canada where province-wide agreements are in effect between the general contractors and the building trades unions, and the commentator points out that the contractor employer has become the greatest organizer for the trade unions, due to the union shop clause embodied in the agreements.

There are many issues which must be resolved, but there are four factors which would undoubtedly help the situation and which could be embarked on immediately. They are:

(1) To establish a uniform expiry date for all construction trades union agreements.

(2) To establish two-year agreements. (Such two-year stipulations can always contain a clause to protect the members in case of a world-wide situation which could cause drastic inflation.)

(3) To make a joint request to the Provincial Government urging fair and equitable amendments to the Trade Union Act. Such amendments to provide adequate protection to unions from unscrupulous anti-union employers, while protecting fair employers from irresponsible picket lines.

(4) To establish local unions in key centres of the Province with a view to eliminating costly transportation and travel-time stipulations.

The opinion is further developed that the idea that we can develop our natural resources by allowing rigid control of building tradesmen from Vancouver is dangerous and unworkable. If a union is certified on a province-wide basis, the onus should be on the union to supply workmen from the closest urban centre—not necessarily from Vancouver. The Provincial Council of Carpenters has recognized this principle by the establishment of some thirty-eight local unions serving the province, thus eliminating to a considerable degree excessive transportation and travel-time costs on jobs far removed from Vancouver.

Management recognizes the immense contribution organized labour has made to the general social and economic betterment and some union leaders recognize the improvement in management's thinking about the welfare of employees. The unions, however, have shown little appreciation of the responsibilities management undertakes when starting a construction project.

Both labour and management face a colossal task, not only in ironing out the present difficulties, but in planning the future—to build hydro plants, pulp mills, pipe lines, oil refineries, bridges, highways, railroads and the many diversified projects which the construction industry undertakes.

The construction industry is basic to the establishment and expansion of all industries. Shown below is an example of some of the difficulties encountered.

Capital Investment

Residential building material costs in 1957 advanced one-sixth of one per per cent from the 1956 average. Non-residential building materials costs rose 1.7 per cent. The greater use of steel and other fabricated metal products which increased in price over 1956 explains the higher rise in costs for this branch of construction.

Employment in the construction industry reached an all-time high in 1957. The estimated average number of workers stood at 78,000, an increase of 8.4 per cent from 1956. At the same time, however, there was a surplus of construction labour throughout the year in most areas of the province, owing largely to the substantial increase in the labour force over the preceding year. Also since some of the larger engineering projects were in the final stages of construction during the year, their labour content was relatively low. Average wages of salaried and hourly paid workers in the construction industry rose to $87.00 per week from $81.13 in 1956. This represents a gain of 7.2 per cent in one year.

Capital expenditures may be divided into two groups—new capital investment and repair expenditures; and each of these may be subdivided in turn into 'construction' and 'machinery and equipment.' The trend towards a higher proportion of expenditures accounted for by new investments continued in 1957. In 1955 new investment in building and machinery was 75 per cent of the total expenditures; it was 80 per cent in 1956 and an estimated 82 per cent in 1957. The percentage allocated to repair expenditures diminished accordingly from 25 per cent in 1955 to 20 per cent in 1956 and to 18 per cent in 1957. But, the usual proportion between building expenditures and expenditures on machinery and equipment was maintained at about 63 per cent for building and 37 per cent for machinery and equipment.

Construction

The total value of construction (new and repair) put in place during the year was estimated at 898 million dollars, up eight per cent from the previous year. Most of this increase was due to the higher value of engineering construction carried out in 1957. Its proportion in total value of construction is about 53 per cent, while in 1956 it was 50 per cent, and 39 per cent a year earlier. Housebuilding declined about 17 per cent from the 1956 value to an estimated total of 168 million dollars, but increases in industrial, commercial, and institutional construction made up for this drop. The total value of building construction in 1957 is estimated at 420 million dollars.

A measure of overall building construction in the organized areas of the province (cities, district municipalities, villages, and regulated areas) is provided by the value of building permits issued. The total for 1957 should reach 245 million dollars, which represents a slight decline from last year's total of $247,096,000. Generally, less building has been done in the established commercial and industrial centres during 1957 than in former years, and more has been done in the suburbs and in newly developing parts of the province. Some of the estimated values of building permits for 1957 are given below (with 1956 figures in parentheses):

Vancouver City, 55 million dollars (64.7 million); Burnaby, 22 million dollars (14.4 million); Surrey, 18.5 million dollars (13.0 million); Delta, 3¾ million dollars (3.4 million); North Vancouver District, 7¾ million dollars (11.5 million); Victoria, 5.5 million dollars (6.7 million); Nelson, 2.5 million dollars (800,000); Prince George, 3.4 million dollars (5 million in 1956 and only 2.8 million in 1955); Prince Rupert, 2¼ million dollars (700,000); Kelowna, 1.5 million dollars (2.2 million); and Kamloops, 1.3 million dollars (2.6 million).

Residential building was at a lower level than a year ago, and there was a general tendency towards a balance between starts and completions, a feature not observed in the past years of considerable expansion in the housebuilding industry.

The total number of houses started this year is estimated at about fifteen per cent less than in 1956, and the number of completions is estimated at a level four to five per cent lower. Lessened activity in the housebuilding industry was reflected in the longer average time that houses were under construction. In 1956 the average number of months was 7.4, while in 1957 it was estimated to be 7.9 months.

Engineering Construction

The total value of engineering construction put in place during 1957 is estimated at 477 million dollars. This is 57 million dollars more than the 420 million dollars spent on engineering projects in 1956. Installations of gas and oil facilities estimated at 125 million dollars contributed the largest single item to this total. Next in estimated value of construction was the road, highway, and airodrome group — 97 million dollars. Construction expenditures on electric power facilities followed closely at 93 million dollars.

Among larger industrial projects in the engineering construction group were the British Columbia Electric Company's thermo-electric plant at Port Mann (11 million dollars) and the Bridge River hydro-electric installation (43 million dollars); the natural gas pipeline in the Interior (75 million dollars); a steel casting mill at Port Coquitlam (1¼ million dollars); electric transmission systems in the Interior (2 million dollars); an aluminum manufacturing plant in Richmond (1 million dollars); and a copper mill at New Westminster (8 million dollars).

Industrial Building Outlook for 1958

A number of building projects were to be carried out or started in 1958. Among the largest are: the B.C. Power Commission's Ash River plant ($10,000,000) and a new hydro-electric development near Alert Bay on Vancouver Island expected to cost around $12,000,000. A transmission line will be constructed from Vernon to Kamloops which will more than triple the available power in the Kamloops area (cost—$1,500,000). A new plywood plant is scheduled for Princeton ($2,500,000); a chemical plant in Vancouver (Pennsalt Chemicals (Canada) Ltd. took an option on a property and they propose to spend $10,000,000); and a wire and cable plant will be constructed at Langley ($1,000,000).

SUBMARINE POWER CABLE

In the October issue of the *Engineering Journal* the general progress of power developments in British Columbia was discussed, and reference was made to the problem of supplying power from the large potential sources of the mainland to the industrial centres of Vancouver Island, which itself has limited resources of electrical power.

This problem was solved on the basis of an original suggestion by Mr. T. Ingledow, M.E.I.C., then chief engineer of the B.C. Electric Company Limited, to use submarine power cables for the crossing of the several stretches of sea between the mainland and the Island. The engineering problems involved were considerable and their resolution plays an important part in the general development of industry in the province.

In brief, the power link involved the laying of lengths of 138,000-volt cable, the first complete link being officially inaugurated in September 1956. A second circuit in this link was put into commission in July 1958. Some of the technical details are given below.

The total length of the link is comparatively short, less than fifty miles, but includes a number of sea crossings, the major one, across the Strait of Georgia being approximately fourteen miles across with a maximum depth of 100 fathoms.

From a preliminary approach to the British Insulated Callender's Cables Group in 1952 regarding the feasibility of such a scheme, positive proposals resulted in the award in February 1954 of an order for the supply and installation of some 91 miles of high-voltage single-core submarine cable.

On the mainland of British Columbia, high voltage power is transmitted at 230kv., whereas on Vancouver Island it is transmitted at 132kv. It was decided that the power to be carried by the cable link, 120Mva., should be transformed down from 230kv. to 138kv. on the mainland and fed to the link at this latter voltage.

The most desirable form of cable was one that could be made in one continuous length without any joints. Obviously, to produce a cable of this type would create manufacturing problems of a very difficult nature besides requiring much special plant. The most satisfactory solution to these problems was to use the single-core gas-filled pre-impregnated paper-insulated type of cable. The use of pre-impregnated paper overcomes the difficulties incurred in tank impregnating very long lengths.

At the maximum depth at which the cable would be laid the external pressure on the cable would be as great as 280 lb./sq. inch. The gas pressure decided upon for this cable was 300 lb./sq. inch.

As finally produced, the 0.35 sq. inch conductor consisted of a central spiral steel duct, over which were applied two layers of copper wires and a conducting screen of three impregnated metallized paper tapes. Pre-impregnated paper tapes were applied over the metallized paper screen to form the dielectric, which is itself screened with copper tape. The lead-alloy sheath, extruded to a shrink fit over this core, is reinforced against the internal gas pressure by three layers of tin coated bronze tape, all applied in the same direction. Between this tape and the jute yarn bedding for the armouring is a protective sheath of vulcanized rubber, capable of withstanding the highest lead sheath voltages liable to occur in service. The cable is armoured with a single layer of galvanized steel wire, applied in a direction opposite to that of the reinforcing tapes to balance torsional forces. The armour is served with two layers of compound jute yarn and the cable has an overall diameter of approximately four inches.

It was decided to manufacture the cable in three distinct operations: stranding, insulating and lead sheathing and, finally, reinforcing, armouring and coiling down.

A completely new cable factory unit was laid out at Trafford Park, Manchester, adjacent to the Manchester Ship Canal, giving the advantage of deep-water berthing facilities. In-line production was most suitable for the manufacture of long, continuous lengths of cable and this necessitated not only many new items of plant but also the considerable modification of standard plant to adapt it for this specialized method of manufacture before being installed in the new unit.

The scheme decided upon by the British Columbia Electric Company was for a.c. power at 60 c/s. to be transformed from 230kv. to 138kv. at Arnott Sub-Station in the Delta area of the mainland of British Columbia. Thence, via an overhead route on wooden poles, the power would be carried to a point at Tsawwassen Beach, just west of Point Roberts. From here, there would be a submarine cable crossing across the Strait of Georgia to Galiano Island. An overhead line, on steel towers would then continue the transmission across Galiano Island, an intervening channel and Parker Island. There would then be a second submarine cable link to a point on Saltspring Island and finally an overhead line across the island and another channel to Vancouver Island, there to be linked, at Stratford Sub-Station, with the main Vancouver Island 132kv. transmission system. In all, the length of line from Arnott to Stratford is approximately forty-eight miles.

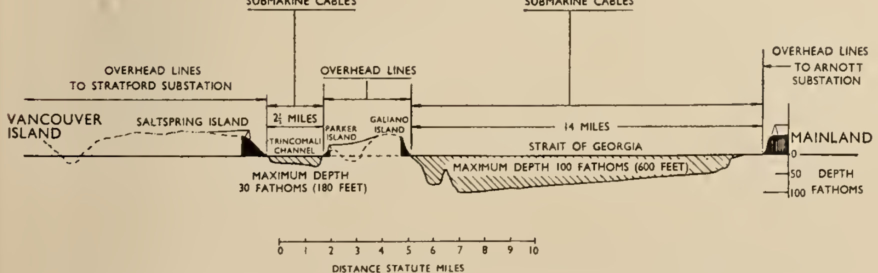
Thus two submarine cable crossings were necessary, the longer one, of approximately sixteen miles, crossing the Strait of Georgia from the mainland near Point Roberts to Galiano Island, and the shorter, of three miles, crossing Trincomali Channel from Parker Island to Saltspring Island. The other water crossings incurred were quite short and were to consist of overhead spans of four-conductor lines.

Cable laying of this kind resolves itself into two distinct parts: laying across the central channel and landing the shore ends. Laying across the channel is carried out by paying the cable out from the moving ship. A method of laying was evolved whereby tension was applied to the cable according to a previously calculated schedule depending on the depth at the point of laying. This schedule was based on a nominal laying speed of three knots.

Cable laying from the 4600-ton *Ocean Layer* started on 18 July, 1956 and continued throughout the following four weeks. For the whole of this period the weather was favourable.

After laying the fourth short length, the cableship and two shore-laying scows moved into Georgia Strait to lay five sixteen-mile lengths. A mile off Galiano Island, the sea bed rises rapidly from 100 fathoms to only forty fathoms, but this did not cause any difficulty. While the laying was in progress, work on the shore ends was proceeding.

Immediately after each cable had been laid, a high voltage d.c. test was carried out on the cable at atmospheric pressure. The cables were then moved into their final positions in the chases and the ends terminated in sealing ends. They were then gassed and the official high voltage acceptance test carried out, together with other electrical tests and a pneumatic test to ensure gas tightness. To prevent damage to the cables, malleable iron protectors were fitted to the cable at the shore end of the concrete chases to below low water mark at the three deep water landings. At the Tsawwassen Beach landing, the protectors were fitted for a short distance from the tunnel entrance, the remainder of the shoreward end of the cable being buried in trenches.



PLANNING . . .

(Continued from page 69)

1. **Report,** Rural Electrification Committee.
2. John Davis, **Canadian Energy Prospects,** March, 1957.
3. Sir Harold Hartley, F.R.S., **What is Energy?,** Esso Magazine, September, 1957, p. 4.
4. **Oil and the Future,** Esso Magazine, September, 1957, p. 32.
5. **Population Trends in Canada, British Columbia, Alberta and Saskatchewan, 1956-1975,** B.C. Research Council, January, 1957.
6. A Brief presented by The Hydro-Electric Power Commission of Ontario to the Royal Commission on Canada's Economic Prospects, January, 1956.
7. **Electric Power Statistics,** Dominion Bureau of Statistics.
8. British Columbia Atlas of Resources, p. 59.
9. **Oil and Gas Journal,** March 10, 1958.
10. **Power,** September, 1957.
11. **The Canadian Study for a Full-scale Nuclear Power Plant,** Atomic Energy of Canada Limited, AECL, No. 557.
12. M. Ward, Director of Planning, The Hydro-Electric Power Commission of Ontario. Modern Power and Engineering, December, 1957.

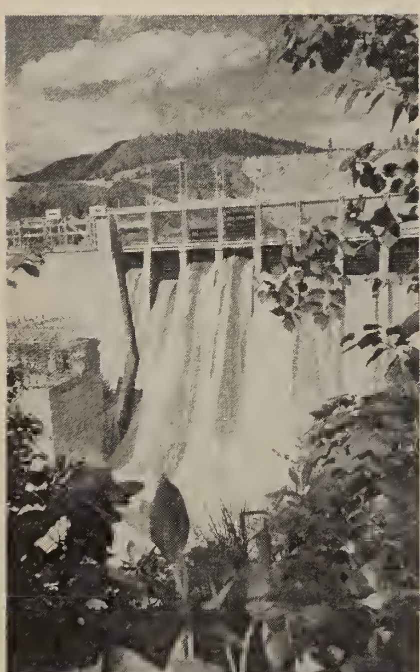
Top left: Old and New Park Bridge.

Top right: Nine Mile Canyon Bridge.

Centre: Agassiz Bridge.

Bottom left: Waneta Dam.

Bottom right: Fraser Canyon, site of new underpass at Thompson Canyon.



BRITISH COLUMBIA

PROGRESS IN A PROVINCE

Above right: an aerial view of Kelowna Bridge.

Left: A typical 100 ton Diesel logging truck.

Bottom left: Old K and S railway near Sandon, B.C.

Bottom right: Bridge over Nanaimo River, Comox Logging Railway.

Top left: Pitt River Bridge.

Top right: Sheepshead claim at Williams Creek—Cariboo.

Centre: Thompson Canyon — C.N.R. Tunnel.

Bottom left: The first wheelbarrow in the Cariboo.

Bottom right: P.G.E. Construction, Howe Sound.

INTERNATIONAL NEWS

The Development of Peat Resources in Ireland

Irish Peat Board

THE NATURAL fuel resources of Ireland consist of a small amount of coal of an anthractic character occurring in very thin seams and a substantial amount of potential fuel in the form of peat bogs.

Peat is a combustible material formed by the humification of such plants as mosses, rushes, grasses, algae, tree debris, etc., under conditions in which the land is of such a nature that large quantities of water can accumulate and are prevented from evaporating rapidly. In such water-logged conditions the rapid multiplication, growth and decay of vegetation takes place. The overlying water cuts off oxygen and a slow carbonisation or humification of the constituents of the plants occurs which forms peat layer on top of layer. Depressions and scars, resulting from the Glacial Period, provided suitable depositing grounds for many peat areas in Ireland.

These bogs occupy approximately 3,000,000 acres of land or roughly one-seventh of the total land area of Ireland. With the establishment of an independent Irish State and the necessity to develop national resources in the interests of national economy, a programme for the development of the bog lands was initiated.

The major physical characteristic of bog deposits which presents difficulties to their utilization is their high moisture content, ranging from 90% to 95%. An intensive drainage programme is necessary before any winning of peat may be undertaken.

Bord Na Mona or the Irish Peat Board which is the authority responsible in Ireland for the development of the bogs, has developed and adapted machinery to meet such conditions and allow almost full mechanical drainage work. Where general bearing pressures for tractors and machinery may be of the order 6 to 10 lbs. per sq. inch it is necessary in the drainage of bogs to provide machinery with a bearing pressure of approximately 1 lb. per sq. inch. The drainage of the bogs results in the moisture content being lowered by approximately 5% and the period required for drainage varies, depending on local topographical and meterorological conditions, from 3 to 6 years.

There are two methods of production at present employed in Ireland, i.e., the sod peat process and the milled peat process. Sod peat which, when dry, is a densely compacted peat of approximately 30% moisture content and in size approximately 12-by 3-by 3-inches is cut by 40-ton electrically powered excavating machines which excavate the peat from near-vertical face banks or trenches of about 12 ft. deep. The raw peat passes through a macerator in the machine and is spread to dry on the bog in sod form. The machine cuts a mixture of the various layers making up the bog. The maceration process causes high shrinkage on drying and results in a dense product. The peat lying for a period of 3 to 6 weeks when it is lifted into small piles mechanically. After a subsequent drying period it is turned and finally collected into storage ricks. From the ricks the peat is conveyed by narrow gauge railway to the railhead for despatch to the consumer. Sod peat is used in the generation of electricity and by domestic and industrial consumers. It may also be used in the production of activated carbon. The calorific value of sod peat at 30% moisture content averages approximately 6,100 B.t.u. per lb.

Machine peat has a high volatile content with an ignition temperature lower than any other solid fuel. It is a non-caking fuel and has a low combustion temperature and a low ash content, and is a most suitable fuel for use in steam boilers, low pressure central heating systems and in ovens, kilns and drying plant.

Milled peat winning consists of milling the surface of the bog over its entire area by a tractor drawn rotating drum on which small cutting blades or pins are fixed. The depth of each cut is about ½ in. and the cut peat is left drying on the bog surface in very small pieces which will dry quickly. To accelerate the drying, harrows are driven over the bog which turn the peat, aerate it and leave it in small corrugations. Some hours later a special type tractor with an angle dozer blade scrapes the loose dry peat into ridges in the centre of each milled peat field. Later a special half track vehicle known as the harvesting machine picks up these ridges and builds a large rick from every ten small ridges. At this stage the peat has dried to about 50-55% moisture content. To achieve a maximum output these operations must be repeated as often during the season as drying conditions permit. In this method of production all operations are completely mechanised. The milled peat process has many advantages over the sod peat process and will figure very largely in future peat development plans in Ireland. This peat, having such a high moisture content must be burned near the bog in electricity generating plants, or converted into briquettes. The economics of milled peat firing for electricity generation have been very satisfactorily demonstrated and, in fact, the electricity generated from milled peat is the cheapest generated in Ireland from fuel. The calorific value of milled peat is 3,500 B.t.u.'s per lb.

Peat briquettes, which are made from milled peat, are used by industrial and domestic consumers. The milled peat is converted into briquettes following screening, thermal drying and pressing. The moisture content of the briquettes is approximately 12% and the calorific value 8,000 B.t.u. per lb.

A further product from the Irish bogs is Peat Moss, which has numerous applications in agriculture and horticulture, and is widely used as a soil conditioner. A considerable export market has been developed for Peat Moss and expansion in production is now envisaged.

Peat is an organic substance and almost anything that can be made from organic substances can theoretically be made from peat, but as it is a low grade product, it is an expensive basis from which to work. Some such products are peat chemical fertilizer mixtures, nitrogenous fertilizers, complete gasification leading to synthetic oil products including rubbers and waxes, partial gasification leading to town gas and coke production and the production of industrial alcohols, sugars, acids and soaps. Most of these products, however, are very doubtful economic propositions and, in some instances, would be economical only in large scale plants.

The peat industry in Ireland has become one of our leading industries. Approximately 100,000 acres of bog land on which 7,000 men are employed are being developed for an ultimate production of 3½ million tons of peat fuel annually. When these bog lands have been cut away, the land will be reclaimable for agricultural production or for afforestation. Experiments are at present being carried out by the appropriate Irish authorities and when large scale areas are available for reclamation the results of these experiments will have indicated most suitable uses for the land so recovered.

Electricity Generation from Peat

GENERATING STATIONS designed to burn peat are included in the post-war construction programme for generating stations in Ireland. Planning included seven sod peat stations of which six are in commission and four milled peat stations, the first of which was commissioned in 1957.

The combined capacity of the peat-fired stations in commission is 145 Mw. or 22.3% of the present total generating capacity of 650 Mw. New plant under construction or on order will increase the capacity of the peat-fired stations to 285 Mw. and the number of units generated from peat to 1350 million per year. The stations are constructed and operated by the Electricity Supply Board.

The capacity of each station is based on the size of the neighbouring peat reserves. Under Irish climatic conditions the average annual peat production is in the region of 30 tons per acre for sod peat and 100 tons per acre for milled peat. Stations are planned on the basis of a 25-year life.

The peat is produced and delivered to the stations by a separate semi-state organisation, *Bord na Mona.* Since 1951 the policy for large-scale peat developments in Ireland has been towards the production of milled peat because of its lower seasonal labour content and its cheaper cost on a calorific basis.

Peat is geologically a young fuel and in its natural state contains approximately 93% water, half of which can be removed by drainage. The physical and chemical properties of peat vary appreciably from one area to another and over the depth of any individual bog. The moisture content of sod peat after air-drying is approximately 35% while that of milled peat is in the region of 55%.

Sod peat is excavated from vertical face banks and spread to dry on the bog as lumps or sods. The excavation machine in this way cuts a mixture of the various peat layers which makes up the bog and gives a fairly uniform product. The average size of the sods as received at the generating station is 8 in x 3 in x 3 in.

Disc ditcher machine excavating bog drain to a depth of 4′ 6″ and spreading spoil to the adjoining areas.

Winning of milled peat on the other hand consists of cutting the horizontal surface of the bog over its entire area by a high-speed rotating drum on which small cutting blades or pins are fixed. This operation and subsequent harvesting give a granular fuel of which approximately 75% passes through a ¼ in. sieve. There is no mixing of the various layers of peat and milled peat has, therefore, larger variations in moisture content and in quality. Its high moisture content and low bulk density make it an expensive fuel to transport and economic utilization is limited to a radius of a few miles from the production area.

The price paid for peat as delivered to the station is varied with moisture content.

The basic price for sod peat is related to 30% moisture, 4% hydrogen and an anhydrous calorific value of 9800 B.t.u./lb. The price paid for the peat as delivered varies in the ratio of its nett calorific value to that of the standard peat. The average basic price for sod peat is 52/6d. per ton. The average fuel consumption is 2.65 lbs. peat/kwh. exported giving a corresponding fuel cost of 0.75 pence. The auxiliary load in the station is normally 5.9%. The moisture content varies appreciably but averages in the region of 32%.

In the case of milled peat the basic price is 23/6d per ton related to 55% moisture. The initial period of operation for the milled peat station in commission shows an average fuel consumption of 4.8 lbs. peat/kwr. exported and a corresponding fuel price of 0.6 pence. As this period includes an appreciable amount of irregular running due to commissioning, these figures for milled peat are somewhat above normal. The present indication is that the figures for normal operation will be in the region of 4.4 lbs. peat and 0.56 pence/kwh. exported. The average load for station auxiliaries is 8.7%.

Peat as a fuel is characterized mainly by its high volatile and low bulk density. Anhydrous peat has a volatile content of approximately 70% while the ash averages 2%. The ash has a low melting point. On a thermal basis the bulk of sod peat is approximately four times that of coal. Anhydrous peat is a highly reactive fuel

*Thanks are due to The Electricity Supply Board of Ireland for the above information.

and when heated does not form a coke but a soft friable char.

As received at the generating stations in either sod or milled form, peat has wide fluctuations in moisture content, density and sizing not encountered to the same extent in the other low-rank or low-grade fuels. It is these variations and their combinations which present the major problems in peat combustion. Seasonal variations in moisture contents give a range of 500-700 B.t.u./lb. for sod peat and 2500-5000 B.t.u./lb. for milled peat. These variations necessitate what might be called a stabilization zone external to the combustion chambers so that the fuel may reach the ignition zone in a reasonably uniform condition.

The largest sod peat boiler installed has a capacity of 220,000 lb./hr. which represents the maximum capacity for this type of boiler because of stoker limitations. Before reaching the stoker the peat passes through a drying shaft where pre-heated air at a maximum temperature of 450°F. is introduced. The depth of the fuel bed depends on the quality of the peat and can be varied from 12 in. to 30 in. The peat is delivered to the station by rail and the wagons are lifted by crane to bunker level.

Experience at the sod peat stations has emphasised the necessity for a long flame path and for shielding the stoker from the radiant heat of the combustion chamber. The flame path in the latest boiler installed is in the region of 40 ft. In the annual maintenance bill stokers constitute the largest single item. This high cost is due to the heavy loads imposed by peat, the small cover of ash on the stoker and the fact that less primary air is required than with the lower volatile fuels.

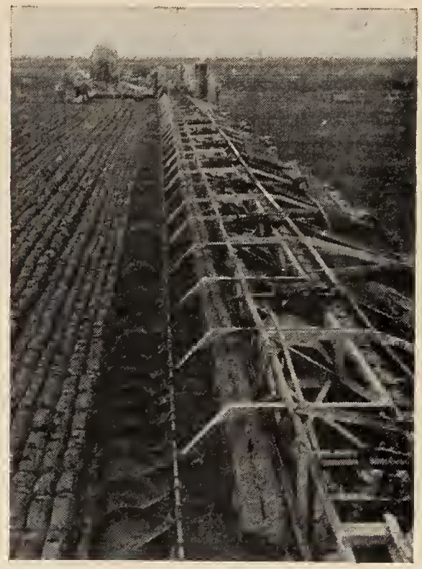
Milled peat has not previously been used on any comparable scale outside Russia for power production and many of the early considerations were, therefore, of a fundamental nature.

The method of drying and grinding of the peat prior to firing is based on the Kraemer mill system used extensively with brown coal. The wide variation in the moisture content of milled peat complicates the drying and gas circuits. The volume of combustion gases at a given load may vary over a range of 1.5 to 1 due to moisture variation and gas recirculation has been provided to stabilize heat transfer to the boiler heating surfaces. Provision has been made for supplying to the mills hot gas from the combustion chamber; cold gas from the flue circuit and preheated air. The mixture depends on the peat quality being fired.

Each of the milled peat boilers has a capacity of 220,000 lb. steam per hr. and the technique of corner firing has been adopted. The moisture content of the peat entering the burners is in the region of 15 to 30% and the temperature of the mixture approximately 200 to 250°F.

The milled peat is delivered to the stations by rail and is then handled by belt conveyors. Special attention was required in the design of bunkers to prevent blockage of the peat at the bunker outlets.

It is not possible at this stage to write in any conclusive way about experience at the milled peat stations as the optimum compromise between operating variables and boiler availability will require more prolonged study. Early experience has, however, shown that the ventilating effect of the mills and an adequately high gas temperature for drying are of primary importance.



Sod peat excavator spreader arm with cutting discs.

SOUTH AFRICAN RAILWAYS

The Government-run South African Railways who have a monopoly in the Union, are busy implementing a great scheme for increased electrification of many of its lines.

Total cost of the scheme will be approximately $100 million. South Africa already has one of the most extensive networks in the Commonwealth, and the largest one in Africa.

In the Orange Free State work is well under way on the 121-mile Vereeniging-Kroonstad section. This project is expected to be completed by June, 1959. The only electrified line in the province at present is a twenty-mile-stretch in the Eastern Free State, on the Durban line to Harrismith.

The programme in Natal has reached an advanced stage and the end of 1958 should see the completion of the work. When that is done, Natal will have 400 route miles of electrified lines.

In the Cape Province, a distance of 210 miles is being electrified. The most important section still to be done is the main line between Touws River and Beaufort West — 179 miles. This is the longest single stretch of electrification ever to be undertaken by the South African Railways and will take nearly four years. When the programme for the Cape has been completed, the total route mileage under electrification will be 435.

A total of 302 miles is being electrified in the Transvaal. All the electrification projects in the Pretoria area should be completed during this year. When all programmes are completed, there will be electrified double lines from Broodsnyersplaas in the Eastern Transvaal to Kroonstad in the Orange Free State, a distance of 220 miles. The line from Johannesburg to Kroonstad will also be electrified.

NEW AIRCRAFT FROM SWEDEN

STOCKHOLM — Parallel with the quantity production of the first version of Sweden's highly supersonic single-seat all-weather jet fighter and attack aircraft Saab-35 "Draken" a new version intended also for export is being developed at the Saab Aircraft Company, it was announced last week.

The new Draken aircraft will be equipped with a more powerful Rolls-Royce engine of undisclosed thrust. This engine and other improvements will make possible a top speed in excess of Mach 2 while the initial rate of climb will be about 820 ft. per second. The flying range and the service ceiling will also be increased.

The aircraft is to be equipped with Saab's new collision-course gunsight and air-to-air rockets. It is also designed to carry heavy ground attack armament, a fact which might be of considerable importance to possible foreign purchasers, it is said.

In September this year a Draken aircraft was the highlight of a big international air display held at the Basle-Mülhausen airport, Switzerland. Subsequently the aircraft was submitted to a two weeks' thorough evaluation by the Swiss Air Force at Emmen near Lucern. The practical tests carried out showed that the Swedish aircraft was able to operate from Alpine airfields and, in spite of its high top speed, also in narrow valleys. Following these tests the Draken was decorated with the Swiss Air Force's unique "Alpine Badge".

GEOTHERMAL ENERGY

In the first few thousands of feet of the earth's crust, the temperature increases with increasing depth below the surface, and it is supposed that heat is generated by radioactivity of the silicic rock which forms this crust. For most non-volcanic regions the thermal gradient lies between 6° F. and 30° F. per 1,000 ft., depending largely on the heat conductivity of the various layers of rock. In spite of these quite large differences of gradient the rate of outward flow of terrestial heat is fairly uniform, averaging about 0.0135 Btu/sq.ft./hr. and, in general, deviating by no more than 40 per cent from this value.

The total flow of heat at the earth's surface is equivalent to nearly 2 x 10^{14} kwh. representing a continuous power output of about 2 x 10^{10} kw. However, use of the energy at the moment is limited to a small fraction of that at volcanic regions where thermal gradients are relatively high and where the heat is more readily available, or to a few non-volcanic areas where the phenomena of natural steam and hot water geysers occur.

In volcanic regions, fissures up to 20 miles in depth may occur in the earth's crust, so that rock in a fluid state (magma) having an initial temperature around 2,000° F. may force itself to the surface. Magma which does not actually erupt, and which becomes trapped again below the surface, will heat the adjacent crust and give rise to temperature gradients, in the first few kilometres, perhaps three or more times as high as normal. Secondary fissures tend to channel the ground water to considerable depths; the temperature of the water is raised through contact with the hot rock and it then returns to the surface. Convection, together with the pressure of water above, tends to maintain the circulation. Water may re-enter the atmosphere either as steam in various states of saturation, or simply as hot water, depending to a large extent, on the quantities of cooler water picked up during the vertical motion. It is this steam or hot water which can be used to meet local requirements for heating or power.

This phenomenon also occurs in certain non-volcanic areas but the primary cause is not definitely known. One of the most noted regions is that at Larderello near Florence in Italy, and it is here that the major progress in the utilization of geothermal energy for the production of electricity has so far been made. In 1954 the installed capacity there was 274 Mw., producing some 2 x 10^6 Mwh. annually. Further development up to 428 Mw. is foreseen. As a result of experience simple power units of 3,500 kw. capacity have been designed. These operate from the steam at its exit point from the ground and exhaust into atmosphere. While not highly efficient in the use of steam, they can be built for low capital cost. Larger, more efficient machines, incorporating equipment for the recovery of chemicals from the steam, have been built in sizes up to 25 Mw.

The steam fields of Iceland, which are of volcanic origin, have yet to be seriously exploited. The rate at which heat is dissipated from these fields is estimated to be some 10^{10} Btu/hr., which is equivalent to a continuous power of nearly 3,000 Mw. Iceland has also many hot springs which are used as the source of domestic and greenhouse heating in Reykjavik and surrounding areas. A central heating system utilizing the natural hot water, which is piped over a distance of 10 miles from its source, supplies 32,000 of the inhabitants and many of the industrial and office buildings with water at about 170° F. It is planned to extend the hot water supply to the whole of the city and to more distant communities.

In New Zealand, where the thermal area covers about 3,000 square miles, exploitation of the Wairakei-Rotorua springs will, by the end of this year, add 70 Mw. of installed power to the main electricity supply. Drilling has been carried out, under difficult conditions caused by the permeable sub-surface rocks, to a maximum depth of 3,360 ft., and tests have shown the source to be capable of easily supporting 150 Mw. of plant. The second phase of the program will carry this out. Total power potential of the region is estimated at 475 Mw. An advantage of the steam here is that it is not charged with chemicals as at Sarderello.

In 1942 a small test plant of 112 kw. rating was operated for a short time in Japan. Continued borings have been successful in proving the wide availability of the source. A 3,000 Mw. power station is planned for the near future.

In the Belgian Congo a 275 kw. plant taking its power from a single hot water spring, has been in operation for many years. Other plants which are projected are for 100 Mw. in California, 50 Mw. in Chile, and two 25 Mw. experimental units in Mexico. There is also an important hydrothermal area in Alaska which has not yet been exploited.

REACTOR IN FRANCE

A GIANT GLOBE is now being constructed near Chinon in the Loire Valley and is intended as a shielded enclosure for a power reactor built by Electricité de France for producing electric power. The globe will have a diameter of 180 feet and is designed to resist an internal pressure of 24 lbs. per square inch. The thickness of the steel plates varies from 25 to 32 inches at the top to 1-3/16 inches at the bottom of the globe. The plates were cold rolled by a completely new process from steel with the relatively high impact strength of 22 ft-lb at 14° F. The average dimensions of the plates are 11 ft 6 inches wide by 30 ft long.

A particular feature of the design is the complete absence of any internal structural members or exterior supports. Upon completion, it will be the largest self-supporting globe ever built, although in actual diameter it will be only the third largest in the world. The base part of the sphere is set in a concrete foundation and a special arrangement at ground level has been provided to eleminate the bending stresses due to the concrete bed and the temperature gradient.

The free-carrying plates will be assembled before erection in sections of three at a time and welded by automatic welding machines. Construction welds will be made with low hydrogen electrodes and all welds will be x-rayed. The specifications prescribe extremely close tolerances.

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

St. Lawrence Seaway and Power Project

Although power was being delivered by eleven generators from the international power-house at Barnhart Island at the end of September, contracts amounting to some $60 million remained to be completed on the entire power project in the international section, with some 4,000 persons still on the payrolls.

Progress by Ontario Hydro

Concrete on the Canadian half of the power-house was all placed with exception of a few 'filling' pours. All of the original downstream cofferdam caissons had been removed. Dredging of the tailrace was deferred until the spring of 1959. Five units were in operation and a sixth almost ready. Installation of remaining units was progressing. Gibson tests for turbine efficiency were being carried out. Employment stood at some 1,700 persons at month-end.

Progress by NYSPA

Several small pours of concrete remained to complete at the end of September on the American half of the international power-house. Tailrace excavation was proceeding within the first tailrace cofferdam, which enclosed about a fourth of the tailrace area. No efficiency tests on turbines had been commenced, but six units were operating, with a seventh almost ready.

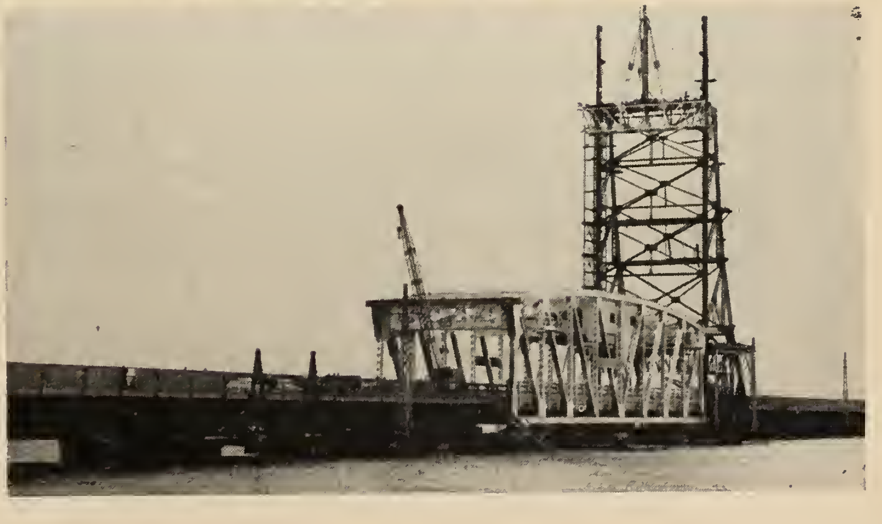
On the Long Sault dam, all tunnels through the dam had been plugged and only small pours of concrete on parapets and bridge walls remained to be completed. Temporary sluice gates in front of the tunnels were being removed, and installation of permanent hoists was proceeding. About half the river-flow was passing through the power-houses. Employment stood at about 2,300 at month-end.

Sweeping the beds of the upstream navigation channels by a barge with a dragging beam continued, to determine spots where the channels lacked 27 ft. depth. It is expected full depth will be attained throughout before freeze-up, though all channels may not be completed to full width.

Progress by SLSDC

With employment down to about 400 persons, some dredging was be-

The new lift span for the Valleyfield bridge was floated into position by Quebec Hydro workers, and installed by Dominion Structural Steel Limited with minimum interruption of traffic. Two lift towers will lift the span 115 feet over the seaway's Beauharnois canal. (Please see Progress by SLSA).



ing continued in the south Cornwall channel. Full width and depth was expected to be attained by freeze-up. On the north Cornwall (Canadian) channel for reducing velocity, dry excavation at some points continued.

The floating lock-gate for the two American locks, damaged last summer at the manufacturer's plant, was still under repair, but delivery was expected by February. On the international high-level highway bridge at Cornwall steel erection was completed, leaving only paving of deck on main span and small pours on approaches to complete. The bridge is expected to be open for traffic early in December.

Progress by SLSA

Bridges: With Jacques Cartier and Caughnawaga bridges virtually completed, bridge work was concentrated on Victoria and Mercier bridges during August. At Victoria bridge on the upstream rail diversion, all piers were in place from the end of the rail embankment at Riverside Drive in St. Lambert to the crossing of the St. Lambert lock. Steel was erected for the rail-highway lift bridge bridge over the existing lock and over the space left for the future twin lock when required. Erection of the lift tower was proceeding. The bridge approach-span over the drainage canal was erected.

At the Mercier bridge, steel erection was completed and concrete deck placed for the northbound lane of the Malone highway approach. On the southbound lane, steel was erected for eight spans on the south end and the deck was being formed for placing concrete. The highway approach from Laprairie to the bridge was carrying traffic.

Early in October a 212-ft., 1,500-ton rail-highway lift span, assembled a mile east of the upstream entrance to the Beauharnois Canal, was loaded on two scows and towed by three tugs to the site of the Valleyfield rail-highway bridge crossing the canal. After one existing span had been removed and stored on pile supports, the new lift span was raised by pumping out the scows and let down to exact position on the bridge piers. With one tower already erected, the second tower and electrical installation will be completed by year-end.

A similar operation was carried out in mid-October for another 212 ft. rail lift span, which will be towed 8 miles down the canal to the existing NYC-St. Louis rail bridge over the canal. The lift towers also will be erected at this site by January.

With work valued at some $35 million including channels, locks and bridges, remaining to complete at the end of September, total employment remained at close to 4,000 persons.

At the St. Lambert lock, paving and fill for approach roads in the area was under way, and clean-up operations were started. A start on similar work would be made at the end of October in the area around the Côte St. Catherine lock, where installation of electrical machinery for the gates and painting of gates continued.

At the lower Beauharnois lock very little concrete remained to place, but considerable finishing and repairs remained to do on approach walls and lock floor. Mitre gates were in position and aligned but not yet set. Dredging continued in preparation for sinking cribs in November at outlet end on Lake St. Louis. A start had been made on roads and paving in the area.

At the upper Beauharnois lock, the guard cribs at the upstream entrance were expected to be placed in October. There still remained some 10,000 cubic yards of rock to remove from the channel bottom between the upper and lower locks. Roads and paving in the area were expected to be completed by year-end. Installation of gates was completed up to prestressing of diagonals and electrical machinery was being installed.

Dredging, though somewhat behind schedule in some places, was proceeding satisfactorily, with the target being to complete a 'minimum channel' by the end of 1958. 'Sweeping' the channels, with scows dragging the riverbed with beams, was proceeding satisfactorily in Lakes St. Louis and St. Francis and along the Beauharnois canal.

The building in Cornwall to house the staff of the St. Lawrence Seaway Authority, under construction during the past two years, was completed in August. Some of the staff moved in during September.

Lakehead Ports

Now that the Federal Government is to participate in seaway harbour developments at the Lakehead, hopes have risen that Port Arthur and Fort William will get new general cargo terminal facilities to handle ocean tonnage. Cost of the terminal is placed at $4 million with completion likely within three years.

The Lakehead is currently equipped with a dozen general cargo sheds with total capacity of some 70,000 tons, sufficient to handle the half million tons of bulk cargo yearly, more than Toronto and Hamilton combined. A five-man harbour commission, with three members government-appointed and one from each of the Lakehead cities, will administer the two ports as one. Currently, dredging of the harbour to seaway standard depth of 27 ft. is under way at both ports.

The Bow River Irrigation Plan

Alberta's $6 million Bow River Irrigation Development, scheduled for completion in November, will serve 50,000 acres of irrigable land in the Lomond-Travers-Enchant areas, fifty miles north of Lethbridge. This is the second system in Alberta to be constructed and supervised solely by the Water Resources Branch of the Provincial Department of Agriculture. Engineers of the Water Resources Branch and P.F.R.A. officials have worked in close co-operation.

The water for the development was taken from a main P.F.R.A. canal running from the Travers Reservoir to Hays. This water is originally diverted from the Bow River near Carsland into Lake McGregor and the adjoining Travers reservoir.

The main canal is 30 mi. long, has a carrying capacity of 1,150 cu. ft. per second. The irrigation water is fed to 7 distributory channels totalling 375 mi. in length. A 30-mi. trunk drain canal leads back to the Bow River.

The irrigated land for the most part will produce feed for cattle and specialized grass seed, it is expected. Alfalfa, tame hay, irrigated pasture land and other specialized crops, will take up a large percentage of irrigated deeded lands.

The Bow River's "Parshall" flume was designed to measure the amount of water going through the main canal by means of automatic instruments. All other structures in the project are calibrated to permit measurement of the flow of water. A radio control communications system aids the management and control of the new irrigation system.

Laval Looks Forward to New Engineering and Science Buildings

At Laval University, the need for considerable expansion of the physical facilities available in the Science and Engineering departments has grown rapidly over the last decade. The two present buildings, erected in 1925 and 1939, were intended to house at most one half of the present student body of over 900.

New space must be made available to ease the present paralyzing pressure and to take care of increasing enrolments for some years to come, Dean of Science Cyrias Ouellet has reported. This would permit long-delayed improvements in laboratory teaching as well as increasing activities in various fields of research. Plans are now being drawn for two new buildings and it is hoped that construction will begin sometime during 1959.

The science faculty has, over the last 20 years, organized courses in several branches of engineering. As the engineering departments came to life one after another, the same original facilities for teaching in the basic subjects continued to be used and thus, the engineering departments have remained closely linked with the science departments under a single academic structure. The first two years are common to all categories of students. The new buildings are being designed so as to make the retention of this closely knit academic structure possible without making it a physical necessity. A balance is sought between the economical advantages of sharing common services and the academic desirability of a reasonable physical segregation at the departmental level and also between the two main groups of disciplines: the engineering subjects and the pure sciences.

The project calls for two interconnected buildings of roughly equal sizes, one for science and one for engineering. These two buildings are to be located in the Cite Universitaire, in the neighbourhood of the new medical building, the forestry building and also of the Science Service laboratories now under construction. The total floor area is estimated at about 600,000 square feet. It is expected that this space will eventually accommodate some 2,000 students and a considerably increased number of research workers.

These two units, linked by a short tunnel, will share a common auditorium, main library, administration space, central workshop and some other services. One unit will house the science departments and also most of the lecture rooms used by the students of the first two years. The other unit will house the engineering departments. Each department, while sharing some of the space available in one of the main blocks, will extend into a wing of its own, behind which ground will be provided for eventual expansion.

In the case of the engineering departments these wings will be high, single-storied structures, permitting installation of heavy equipment and leaving possibilities for vertical and horizontal subdivision. Much of the space will consist of relatively large areas inside which movable partitions will permit reallotment according to a standardized modulus. In each department, facilities for research and advanced undergraduate teaching will, where feasible, be grouped in the same region and sheltered from the more busier areas.

A Report on Growth in the Engineering Faculties in Canada

Eleventh article of a series

Nova Scotia Technical College Anticipates Future Requirements

Engineering education in Nova Scotia takes a different pattern from the rest of Canada.

The province is served by four universities,—Acadia, Dalhousie, St. Francis Xavier, and St. Mary's. The present system is really a heritage from the past, in which the first three years of engineering training was taken at the various "Associated Universities" and the last two years given at the Nova Scotia Technical College, which was established for this purpose in 1907. In addition to the Nova Scotian universities mentioned, Memorial University of Newfoundland, Mount Allison University, and the University of New Brunswick, are included in the group known as the "Associated Universities". Entrance to the three-year course in engineering at these universities is based on junior matriculation.

The Nova Scotia Technical College therefore gives undergraduate instruction only in the fourth and fifth years of the five-year course, and deals only with the more senior aspects of engineering education. There are at present 26 members on the teaching staff, ranking from assistant professor upward, and the current registration is 300 students. The small campus of approximately eight acres is situated in the heart of Halifax, and includes the electrical, mining, mechanical, civil, and administration buildings.

Within the last few years the curriculum has been reshaped to conform with the modern requirements in educating engineers whose careers extend some forty years into the future. The emphasis has been placed firmly on the fundamentals of the physical and applied sciences, with a reduction in the proportion of time allotted to the study of current practice. This is regarded as the appropriate method of educating for the coming era of burgeoning technical activity, President J. Hoogstraten reports.

Students with exceptional talent are admitted to the honours course in which additional work in a major advanced study is undertaken. The purpose of this opportunity is to enable the exceptional man to secure a broader and deeper knowledge of some portion of the field.

A new $800,000 building is now being planned by C. A. Fowler and Company, architects. These plans currently envisage a lecture room and draughting room wing attached to the south end of the present Macdonald Building, reaching towards Barrington Street and terminating with an administration and library wing parallel to the Macdonald Building. A laboratory wing extends southward, generally in line with the existing Macdonald Building. The open areaways under the lecture-draughting room wing, and also at the north end of the administration wing, will lend a feeling of spaciousness on a crowded campus. It has been decided, as a matter of policy, that no classes shall exceed 40 students in number, and classrooms and draughting rooms are planned to accommodate these numbers. The lab wing will house a new mechanical laboratory, and all electrical engineering laboratories will be re-established here. It is expected that further building will be necessary in 1965.

The Alumni Association is presently engaged in raising $300,000 for the erection of a gymnasium and auditorium. It is expected that construction will begin about 1960.

Calgary Campus Planned

Tentative plans for the proposed campus for the University of Alberta to be located in Calgary were presented to the Council of the City of Calgary in October. The plans were outlined by representatives from the Department of Public Works and the Board of Governors of the University of Alberta.

The site which is located west of 16 Street N.W. and south of the old Banff Trail, provided by the City of Calgary, comprises approximately 312 acres.

Initial plans call for the erection of an Arts and Education Building and a Science and Engineering Building to be in service for the fall term of 1960. Subsequent buildings will proceed as student population and student requirements expand.

Commencement of construction is now awaiting the provision of sewer and water mains by the City of Calgary. It is anticipated that construction of the first two buildings will start in the spring of 1959.

Canadian Pipeline Projects

Westcoast Transmission

The $7 million extension of Westcoast's natural gas gathering system northwest of Fort St. John was completed in mid-September and went into operation later in the month. The 84-mile extension, roughly following the Alaska Highway, will tie in 21 more gas wells and add 80 million c.f.d. for delivery to the processing plant at Taylor, B.C. Ultimately the extension will add 150 million c.f.d. to the gathering system's capacity. More than 300 men, 90 per cent of them Canadians, were employed at peak periods, nearly half the pipe used was of Canadian manufacture and cost over $1 million. The balance came from Kaiser Steel Corporation.

Alberta Gas Trunkline: BA Oil formally opened two major plants costing a total of $50 million in mid-October. The Pincher Creek gas-processing plant, which commenced delivery of gas at end of September, was dedicated October 15, while the Port Moody refinery near Vancouver was ready for public opening October 17. Completion of the Pincher Creek recycling plant makes British American the largest supplier of natural gas to the Trans Canada pipeline. It will have a daily initial production capacity of 13,700 gallons of propane, 20,000 gallons of butane, 450 long tons of sulphur, and will deliver 70 million c.f.d. of gas the first year of production.

Canadian Western Natural Gas: Reflecting the vast expansion of the Company's services throughout southern Alberta, an official estimate predicts CWNG will be serving 82,750 customers by end of 1959, compared with 24,300 twenty years previously. This year the towns of Enchant and Vauxhall were added to the system. Next year, Carmanguay Champion, Kirkaldy, Barons and Vulcan will be served.

Sask. Power Corporation: Early in September S.P.C. dedicated its 90-mile, 14-inch trunk pipeline carrying 383 billion cubic feet or more yearly from the Hatton-Many Islands field on the Alberta-Saskatchewan border. The line extends to S.P.C.'s Success-Moose Jaw system. Some 211 billion cubic feet per year in the Many Island field were dedicated to this line.

Construction was nearing completion early in September in southeastern Saskatchewan on the natural gas conservation plant of Steelman Gas Ltd. The plant is the first in the province designed to produce sulphur from gas, and the first to produce liquid propane from casinghead gas. Total expenditures to end of August were $7.1 million, well within budget estimates. Underground storage for propane in salt wells at Melville is provided by two storage wells and a brine disposal well. International Sulphur Co. will purchase the sulphur with a floor price of $19 a ton. Plant is designed

A few of the 24 large tanks which give the B-A Pincher Creek plant a storage capacity of 336,000 gallons of LPG products and 24,000 barrels of condensate.

to produce 25 MMc.f.d. with ultimate expansion to 45 MMc.f.d.

Trans Canada Pipelines

Trans Canada, already serving the Lakehead area, expects to be delivering over 130 billion feet yearly by the fifth year of operation. Ontario uses about 14 per cent of the country's energy, of which 91 per cent is imported at present. The rapid growth of Ontario's gas market is largely responsible for an unexpected need for expanded delivery facilities by 1961/62. Trans Canada sees a need to double capacity by that time.

At the end of September construction of the entire mileage between Lakehead and Toronto on both the Northern Ontario Pipeline Crown Corporation section of 367 miles between Port Arthur and Kapuskasing and the wholy owned 486-mile Trans Canada section between Kapuskasing and Maple near Toronto.

Final tie-in welds had been made on all 1958 mainline construction except for the loop sections and some of the river crossings. It was expected pigging, purging and pressure testing would be finished ahead of the scheduled completion date of November 1st. The year's program also included five compressor stations.

Northern Ontario Natural Gas expects deliveries by end of 1958 to reach 72 million c.f.d. and by end of 1959 up to 103 million c.f.d., nearly its Trans Canada contract maximum. The company, and its affiliate Twin City Gas, will serve 34 communities on the 1,100-mile route of Trans Canada east of the Manitoba boundary with some 800 miles of distribution mains and service lines and 180 miles of laterals and intercity connections, costing $22 million. They have already contracted to supply 60 per cent of industry's total fuel needs in the franchise areas. Three Lakehead mills of the Abitibi Power and Paper Co. have been converted to natural gas. Combined consumption could reach 7.7 million c.f.d. Northern Ont. Natural Gas and Twin City now hold long term contracts for nearly 60 million c.f.d. to eleven miles between Kenora and Orillia.

Two Export Applications Temporarily Rejected: The Alberta Conservation Board rejected late in September applications for two companies wishing to export gas to Pacific States, namely Alberta Southern and Westcoast Transmission. The former had asked a permit to export 4.2 trillion feet the next 25 years, while the latter had sought permission to export 1.3 trillion feet.

Pointing out that of the 23 trillion c.f. of gas reserves, only 4.1 trillion feet was surplus to present and future Alberta needs, the Board suggested the two applicants scale down their demands by about 25 per cent. They were told their applications would be reconsidered at new hearings before the end of the year.

B-A Port Moody Refinery

Port Moody, B.C. is the site of the British American Oil Company Limited's largest refinery. The $25 million installation, which covers a 380-acre area, will have a 20,000 barrel per day capacity of petroleum products. Two miles of 12-inch pipe line connect the Burnaby, B.C. terminus of the Trans-Mountain pipeline and the new refinery. Trans-Mountain supplies crude oil from Alberta oilfields. Ultimately these lines will be capable of supplying the refinery with 80,000 barrels of crude per day.

The Port Moody location offers the proximity of the market centre of metropolitan Vancouver, as well as favourable taxation rates, it is reported. The company intends production of a full range of petroleum products, high octane gasolines, stove oil, diesel oil, and others.

The Port Moody plant is supplied with the most modern of equipment.

An alkylation unit which produces a material expressly designed to raise the octane of gasoline is part of the new refinery. Liquid gases, such as propylene, butylene and amylenes, produced in the refinery are combined with isobutanes to produce an alkylation reaction and are processed with sulphuric acid. A motor alkylate is produced and is finally blended with gasoline, resulting in a higher octane rating.

B.A.'s first middle distillate unit has been set up at Port Moody. A cobalt molybdate catalyst promotes the reaction of sulphur with hydrogen. About 75 per cent of the sulphur content of the feed stock is eliminated. This results in superior burning and heating characteristics.

One of the two great steam producing boilers is of the carbon-monoxide type, capable of producing 85,000 lbs. of steam an hour. About 30 per cent of its fuel is waste gases from the catalytic cracker.

Automatic gauging equipment maintains a constant check on the level and temperatures of the big tanks. Workers at Port Moody simply dial the number of a particular tank to obtain this information from electronic equipment which covers the entire refinery.

A new development is the automatic blending equipment on process units. All-electronic instrumentation is used to blend gasolines.

For its largest refinery, B.A. has

B-A Refinery, Port Moody, B.C.

provided a maximum of fire protection. A fire truck is provided which can carry 1,000 gallons of foam and is capable of refilling during pumping. It can discharge 9 streams of foam, and four streams of cooling water.

The refinery also maintains a double source of electric power from the B.C. Electric Company's 60-kv. main transmission line nearby. An automatic throw-over switch gear can draw power from the second line, if necessary, without interrupting plant operations.

Montreal-Laurentian Autoroute

The Montreal-Laurentian Autoroute, construction of which began in August 1957, is expected to open in November 1959 for the full 29-mile route. A 9-mile section will be opened to traffic during November this year — the stretch between Cremazie Blvd. in Montreal and Ste. Rose, Que. Two thousand men were employed on the project during October.

The Autoroute will link Montreal's Metropolitan Boulevard, running east to west across the island, with the provincial dual highway, one mile north of the City of St. Jerome, Que. Motorists will be able to travel at a rate of 70 miles an hour, travelling the full distance in about half an hour. Ernest Gohier described the project at the Canadian Good Roads Association annual meeting in October, 1958. He is the chairman of the Montreal-Laurentian Autoroute Board, a Provincial authority.

Right of way is 200 ft. wide for the first three miles, and 300 ft. for the rest of the way. At the full clover leaves or interchanges the width is 1,200 ft.

Three traffic lanes in each direction are separated by a 40 ft. or a 100 ft. mall. The four outside lanes are 12 ft. wide; the two passing lanes 13 ft. wide. Acceleration and deceleration lanes are 12 ft. across, and vary from 1,000 to 1,200 ft. in length to permit perfect weaving of traffic.

The two main bridges, one over Rivière des Prairies, 1,850 ft. long, and one over Thousand Island River, 3,300 ft. long, are 92 ft. wide. They have steel superstructures resting on concrete abutments and piers, with reinforced concrete slabs 8 inches thick. Four shorter bridges of the same type cross the North River.

Forty underpasses and overpasses are built of reinforced concrete. Composite structures of steel and concrete are used at four railway crossings.

Bridges, underpasses and overpasses are built to H-40 standard. Each has 6 lanes. Fourteen interchanges serve the already settled communities along the route.

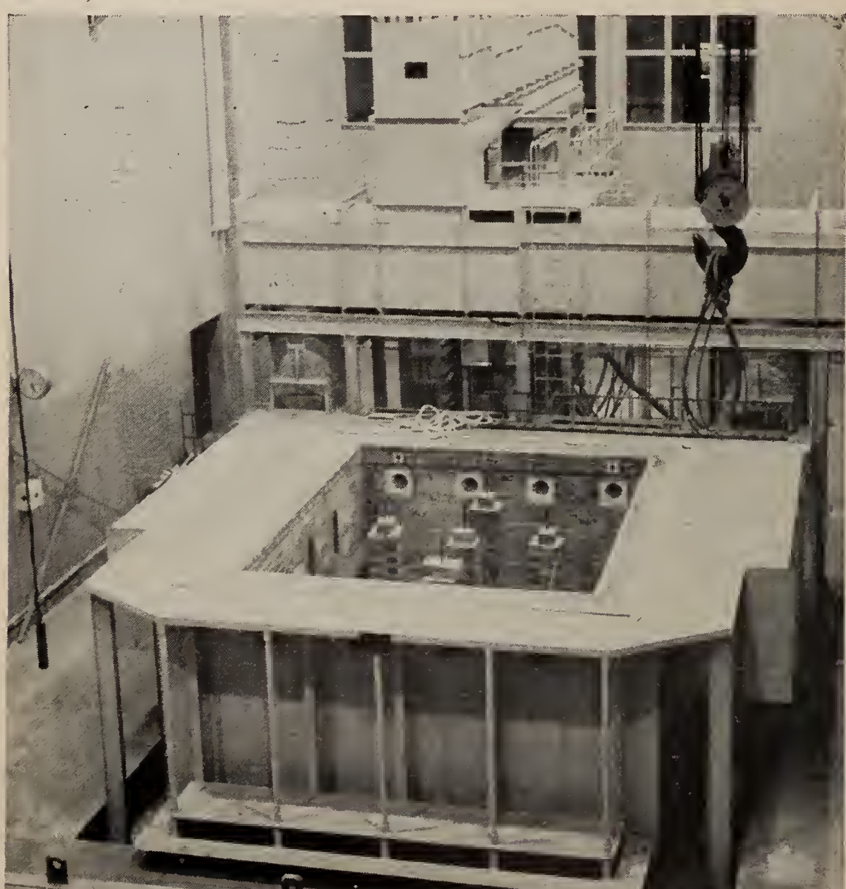
Three toll gates, each with 12 paying booths, are planned for minimum interruption of traffic.

The profile of the autoroute shows a maximum grade of 3 per cent (at loops, 5 per cent). Maximum degree of curvature is 2 degrees and 30 min.

Pavement on the Autoroute consists of a uniform 8-inch thick reinforced concrete slab. Transversal expansion joints are provided every 200 ft. and paved contracting joints every 40 ft. Clover-leaf loops are surfaced with a 300-lb. hot asphalt concrete pavement.

Designed for an axle load of 28,000 lbs., the roadway structure is composed of a compacted sub-grade; 4 inches of filter-type sand and stone cushion; 8 inches of crushed compacted stone; two inches of sand or ¾ of an in. of run-of crusher stone for the fine grading; and 8 in. uniform reinforced concrete slab.

Furnace laboratory in the Fire Research Building of the Division of Building Research, National Research Council.

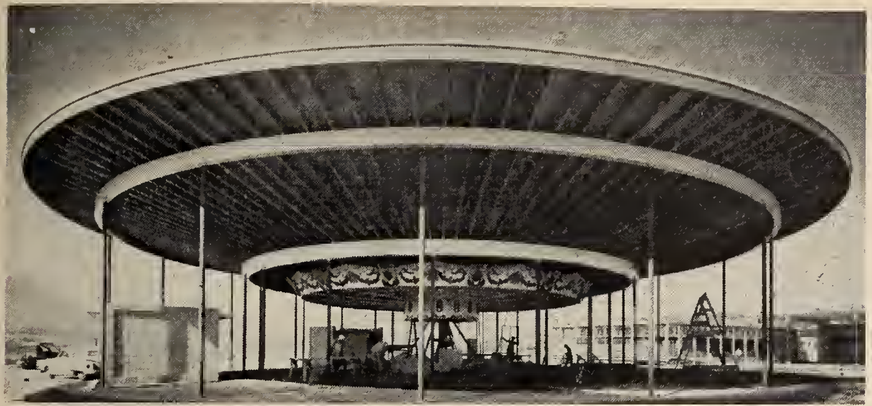


Fire Research

The fire research laboratory of the National Research Council, dedicated on October 3, covers an area of 20,000 sq. ft. Of a total volume of 550,000 cu. ft., nearly one half consists of a 40-ft. high laboratory housing two large furnaces.

One of these, used for research into the fire resistance of wall structures, will accommodate panels 14 ft. by 14 ft.; the other is a floor furnace accommodating floor structures 12 ft. by 15 ft. In both furnaces the specimens can be loaded to maximum working capacities prior to the application of heat in accordance with either ASTM or BSI standard test procedures. There are also chemical and physical laboratories, a special room for carrying out model burns, and space for research into the hydraulic aspects of fire fighting and fire prevention.

The proceedings of a two-day conference which preceded the official opening of the fire building, will be published by the Division of Building Research.



Carousel at P.N.E. Grounds, Vancouver.

Engineered Timber in Construction

Special fabricating techniques employing B.C. timber, used on a $1 million project in British Columbia saved approximately five weeks construction time, it is claimed. Prefabricated piece by piece away from the building site, the largest roller coaster in Canada and a giant carousel were completed for the Pacific National Exhibition Grounds by Timber Preservers Limited, during the past summer. The architect was Douglas Miller of Vancouver.

The roller coaster, using approximately 256,000 f.b.m. of lumber has more than one-half mile of track and will rise to a height of 72 ft. at its highest point. It consists of 284 bents of 10 ft. spacing, with the bents preframed and bored, using 4 in. by 6 in. structural Pacific Coast Douglas fir braces. The structure, designed to withstand wind velocities in excess of 90 miles per hour, specified the use of pressure-creosoted Douglas fir piling together with 12 in. by 12 in. caps.

Speeds up to 60 m.p.h. can be attained on the 45° angle runs. Bracing of the structure, running parallel to the ground is spaced at 5 ft., is overlapped and fastened with spiral nails. The track consists of 8 layers of wood and cross ties. Many structural members were pressure treated with Wolman salts for increased strength.

The carousel which has an outside roof diameter of 102 ft., was also constructed by the preframing and prefabricating technique. The roof is formed from large pie-shaped arched sections of plywood, 25 ft. long. The method used was to erect a false stage to support the carousel centre steel ring to a height greater than the centre glued laminated ring. The inner glued laminated timber ring carries vertical roof loads, whereas the horizontal thrust from the inner portions of the roof is contained by a welded steel plate ring precision fitted around the inner glulam ring of 29 ft. radius.

Other structures include a whip building, scooter building, a concession building and covered midway. They employ plywood boxed beams and structural laminated members, in combination with other materials.

The drive-in restaurant building was designed with glulam beams radiating from the centre steel column. All the posts supporting the roof and floor are run down to concrete bearing walls or pedestals. The novel Douglas fir plywood gussets within the posts were designed to allow greater cantilever without increasing the size of the glulam beam. The plywood itself provides lateral stability. The entrance walls are of rough stone.

In one structure glulam trusses salvaged from a bridge project were used again as a building material.

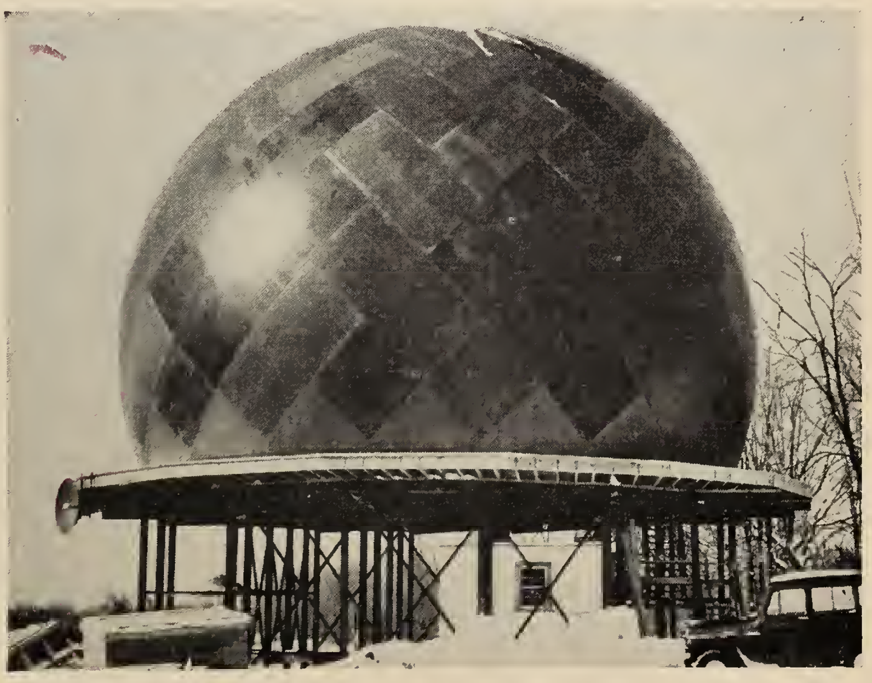
Epoxy Radome

A ground-based reinforced epoxy radome has been designed, built and erected by Long Sault Woodcraft, Ltd., St. Andrews East, Quebec. It stands 40 ft. high and weighs 9,000 lb. It has a 50 ft. base diameter and 55 ft. equatorial diameter. The prototype radome, which was built under contract to Rome Air Development Center, U.S. Air Force, Rome, New York, was assembled earlier this year. Other units of the same size are under way, but Long Sault engineers say that the stressed laminated skin type of construction makes possible even larger ones — of 100 ft. and even 200 ft. in diameter.

The lightweight rectangular panels of the radome are designed so that the entire unit can be knocked down and shipped in a single aircraft. It is fire- and weather-resistant, and can withstand winds greater than 150 m.p.h. at sub-zero temperatures. Six men can erect the radome in only 1½ working days.

It consists of 156 individual contoured panels, the largest near the equator weighing 100 lb. and measuring 6 by 12 ft., and the smallest near the pole being 3 by 5 ft. A panel is made by preparing two skins, each consisting of two plies of glass cloth reinforced with a formulation of Epon* 828 (Shell Oil Company of

Ground based reinforced epoxy radome, built in Quebec



Canada, Limited) and a curing agent. A one inch paper honey-comb core is then bonded between the two skins. A sheet of Dynel fabric on the outer surface of each panel provides not only fire resistance, but also an additional reinforcing layer for improved weather resistance.

From a structural point of view, design of the radome is that of a sphere in which loads are carried uniformly throughout the structure.

Joints are arranged to cross the surface at 45 degrees rather than vertically or horizontally. This means that panel joints do not interfere with either search or height finder radar sets. Surface of the radome is entirely spherical rather than faceted. The individual panels are attached to each other by 1,500 cam-actuated locks closed by a ¾ turn.

Saskatchewan Research Council

The Saskatchewan Research Council, moving into recently completed laboratories on the University of Saskatchewan campus, can apply itself to still wider interests. In its ten-year history it has worked on research and investigation in the physical sciences, pure and applied, aimed primarily at improving the provincial economy. These aims have been implemented mainly by research at the University, sponsored by the Council through grants to the University and scholarships to graduate students. Since 1955 a Technical Information Service has been available to industry. In 1956, T. E. Warren became director of the Council.

There are six divisions: the physics division, headed by Dr. T. P. Pepper; chemistry, Dr. E. J. Wiggins; engineering division, W. H. W. Husband; geological division, Dr. J. R. Smith; technical information, I. S. Evans; and a biology section.

Notable projects are:

A Lignite project: studying the carbonization of lignite, which is produced in Saskatchewan to the extent of two million tons annually. Work on the efficient use of lignite was sponsored by the Saskatchewan Power Corporation.

Carbon dating: Improved method of measurement of age of materials by a carbon 14 apparatus.

Rape seed oil: development of a lubricant from rape seed would provide an alternative crop for Saskatchewan farms.

Building and highway foundation problems: Long term savings are attributable to this project, which studied methods of building foundations on clay.

Thirty-six projects now being sponsored by S.R.C. are discovering new methods, new materials and new markets.

What Goes On

Export Credits Insurance Corp.

Five new members have been appointed to the Advisory Council of the Export Credits Insurance Corporation, a Crown Company which insures exporters against non-payment by foreign buyers.

Those just appointed are: Hon J. V. Clyne, chairman of the Board, MacMillan & Bloedel Limited, Vancouver; H. G. De Young, president, Atlas Steels Limited, Welland; Raymond Dupuis, president, Dupuis Freres Limited, Montreal; A. C. McKim, president, Merck & Co. Limited, Montreal, and F. G. Rutley, chairman of the Board, The Foundation Company of Canada Limited, Montreal.

They serve with others remaining on the Council: Hon. Hector Authier, Amos, Que.; R. B. Buckerfield, Vancouver; James S. Duncan, Toronto; Raymond Garneau, Quebec; H. G. Hesler, Montreal, George W. Robertson, Regina, Sask.; Fletcher S. Smith, Halifax, James Stewart, Toronto; K. F. Wadsworth, Toronto; F. Homer Zwicker, Lunenburg, N.S.

New Brunswick Industry

Many of the items imported for the Atlantic Provinces market could economically be produced there. However, the low volume of that market is a deterrent.

At the same time, manufacturers, through changing conditions or for other reasons, periodically find their plants with surplus production capacity.

The New Brunswick government advises the relating of these two circumstances, as a way to open opportunities for expanded business. The method would be a working arrangement with another manufacturer to make his products with existing facilities, to cater to the limited markets. Overhead savings, elimination of tariffs or transportation charges could

Wolverine Tube plant, Calumet Hecla of Canada Ltd., London, Ont.

place such products in a preferred competitive position.

The Department of Industry and Development, New Brunswick, is exploring the potential with provincial manufacturers and with those presently exporting to the area or to Canada.

Canada's Exports

"Canada's exports to date have shown strong resistance to the downward tendencies in world trade at large", it was reported by John H. English, Deputy Minister of Trade and Commerce, in September. There was a more than two-fold increase in one of Canada's new exports — uranium, he said. Other items had been sold abroad in substantially larger amounts this year, such as aircraft and farm implements.

It was evident that many Canadian industries were successfully weathering the competition from imports, Mr. English said. He mentioned particularly the iron and steel industry where operations had at no time fallen below 72 per cent of capacity.

Efficient Productivity

Speaking at the annual meeting of the Canadian Chamber of Commerce, in October, in Montreal, retiring president R. C. Pybus, M.E.I.C., of Vancouver, said "It is my belief and it is the thinking of our Canadian Chamber of Commerce that efficient productivity is the key to our continuing prosperity and our defence against the cost price squeeze. We must increase our engineering skills, our research and technological developments. We must increase efficiency in management and in Government, and create a desire for the worker to be interested and industrious in his or her work.

"It will require cooperation between labour leaders and management and a realization that labour, management, government and capital are as a team which must work and pull together for our economic welfare and in the interest of all, which is indeed enlightened self-interest."

Western Copper Mills Ltd.

By means of a recently concluded agreement between Western Copper Mills Ltd., Harrisons & Crosfield (Canada) Ltd., and Harrisons & Crosfield (America) Inc., there will be world-wide sales representation for the products of Western's mill now nearing completion on Annacis Island in the Vancouver area.

Harrison's president said that sales will be made through established Harrisons offices in Canada and the United States.

Construction of Western's fully integrated copper alloy tube, rod and bar mill, covering nearly five acres, is to be completed late this year. It is equipped to produce up to 3 million pounds of copper water tube, copper and brass pipe, refrigeration tube, automotive tube, condenser tube, electrical bus conductors and brass rod per month.

Wolverine Tube Plant

Full operation of the tube-producing facilities at Calumet & Hecla of Canada, Limited, Wolverine Tube Division plant at London, Ont., was announced in September by D. D. C. McGeachy, M.E.I.C., vice president and general manager of the Company.

The plant, a source of non-ferrous seamless tubing, since its first shipment in April has approached the 1,500,000 pound mark. With full production, the planned production of 1 million pounds per month may be exceeded.

Some features of the industrial development are:

- Architectural design uses colour scheme to unify separate buildings
- The dominant building, the 820 ft. x 140 ft. tube mill, has 85,000 sq. ft. of manufacturing space, providing a clear height of 29 feet to the underside of the 100-foot span steel trusses. The mill building is free of columns.
- The mill includes a casting shop of 12,000 sq. ft., where raw metal and scrap are melted and poured into billets.
- The service area and boiler house running parallel and adiacent to the mill, contains electrical and millwright maintenance shop, tool shop, supply crib, engineering office, physical and chemical testing laboratorv. The area totals 24,000 sq. ft., including 7,000 sq. ft. for the boiler house.
- The administration building, and the gatehouse and personnel building are parts of the scheme.
- Pump house is provided, where 500,000 gallons of water are treated for industrial re-use.
- Each building can be enlarged in a pre-determined direction, according to a plan.
- Duplicate 3-phase, 60 cycle, 27.6 kv., three wire electric power services are obtained from the Ontario H.E.P.C. and terminate at the outdoor plant substation.
- Two 100-hp. boilers take care of the steam and hot water requirements of the plant. They are of the packaged four-pass forced draft type, each rated at 500 sq. ft. of heating surface, 3,345,000 B.t.u. per hour output, and 3,450 lb. of steam per hour.
- Production is essentially a cold drawing or cold working process, with modifications for brass tube working.
- Statistical quality control is used for all operations.

Automobile of the Future

The "new and different car" of the future was described by Gordon E. Grundy, president of Studebaker-Packard recently. It will be a car that is amply big enough for passenger comfort, but not excessively large; that has all the power needed for every sensible motoring demand, but not more; its basic design incorporates simplicity and elegance, but avoids superficial ornamentation.

Mr. Grundy said that his company is in process of tooling up for production run of a new type of car combining the best qualities of European and North American cars.

Ferranti Business Transactor

Ferranti-Packard Electric Limited, entertaining A.I.E.E. delegates to the Toronto plant, demonstrated the company's business-transactor, adaptable to reservation systems or inventory control where points of input are physically or geographically separated.

In the power transformer division, automatic core steel handling equipment was demonstrated. Five-ton rolls of sheet steel were seen being slit lengthwise while running at 200 feet per minute, and then the strips cut to length with an accuracy of ±.002 in., in a continuous operation. The machine stacked the cut material readv for assembly into "boltless" transformer cores.

Refining Unit for Yukon

The Yukon Territories will benefit by a $1 million refining unit when Alaska-Yukon Refiners and Distributors Limited, a Canadian company with headquarters at Edmonton, constructs the installation at Haines Junction, Y.T. The engineering design and construction will be the responsibility of the Fluor Corporation of Canada Limited.

The refining unit, a new industry, represents a forward step in the territorial development program. The Haines River plant will be a products treating and separation plant capable of handling a through-put of 3,000 barrels of oil dailv, and will produce asphalt of several grades as well as stove, diesel and bunker fuels for distribution in the Yukon and Alaska regions.

The acquisition earlier this year of one of the Canol pipelines used in World War II, from the United States, and the imminent turnover to the Yukon of the remaining ones transfer of which is being negotiated, will aid the distribution of petroleum products in the remote northern area.

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

CONFEDERATION — A Progress Report

The chairman of the E.I.C. Committee on Confederation, Dr. Irving R. Tait, presented the following report to Council at its meeting on Saturday, October 25, 1958.

"Since the last report, presented to the September meeting of Council, the Institute panel of the sub-committee has met three times, and the whole sub-committee has met twice. Mr. Foulkes, vice-chairman of the Institute panel, came from Ottawa to Montreal for two of these meetings.

"The sub-committee reached accord on all points, and are now submitting their report and recommendations to all members of the joint committee. It is planned when all committee members have approved, it will be submitted to the Council of the Institute and to the Canadian Council.

"The sub-committee report recommends unanimously that the two bodies take the action necessary to bring about Confederation. The next steps are clearly defined. The first step is to have the councils send the proposal to all members with a ballot asking their approval of the overall general plan, and their authority to set up a provisional council. This provisional council will then proceed to set out the final details for Confederation including the necessary by-laws.

"The second step recommended is that the final proposals of the provisional council be sent to all members with a ballot asking for their approval. If the ballot is favourable Confederation will be inaugurated as soon as the necessary arrangements can be completed."

Council discussed this report on Confederation at great length and expressed its appreciation and pleasure at the considerable progress that had already been made.

Several councillors inquired when the ballot of all members, referred to in the report, might be held. Dr. Tait replied that, if nothing unforeseen happens, the first vote mentioned in his report would probably be held during the first half of 1959.

Meeting of Western Councillors, at Calgary, October, 1958

The first trial meeting of Councillors in Zone A (the Western Provinces) was held in Edmonton in March 1958, and was so successful that it was decided to continue the experiment this year. The councillors are constituted as an Advisory Committee of Council as a whole on matters affecting the Western Branches.

Accordingly, a meeting was called for the forenoon of Saturday October 18 in the Palliser Hotel, Calgary. Present were the late S. C. Montgomery, vice-president, in the chair, and Councillors F. M. Cazalet, Vancouver, D. Cramer, Lethbridge, P. F. Fairfull, Victoria, W. K. Gwyer, Kootenay, N. M. Hall, Winnipeg, W. F. Hayes, Saskatchewan, R. N. McManus, Edmonton, P. M. Sauder, Association of Professional Engineers of Alberta, and T. D. Stanley, Calgary; Past-Councillors J. B. Mantle, Saskatoon, and W. A. Smith, Calgary. Also present were F. L. Perry and O. O. Junker, chairman and secretary of the Calgary Branch. The Western Field Secretary, A. C. M. Davy acted as secretary.

The meeting lasted for about four hours, following which a reception was held by the Calgary Branch for the visitors.

Among the interesting topics on the agenda was the proposal to hold a two-day Regional Technical Meeting next October, in Banff. Professor Mantle, chairman of a committee set up in March to study the possibility of holding such a meeting, reported that the replies to a questionnaire sent out by him to the Branches showed sufficient interest to justify proceeding with the project. Further information, notices and so on will be forthcoming as plans develop. Chairman of the Conference Committee is W. Smith.

Confederation, of course, came in for its usual lively discussion, but in view of the existence of the two committees working in Montreal, no formal steps were taken.

Altogether, the meeting was very successful. It was the general opinion that these meetings have great usefulness in drawing together the widely scattered membership in Zone A. Perhaps they do more good by strengthening the loose-knit ties of the membership than by any formalized passing of resolutions.

The whole event was saddened by the tragic and sudden death of the Vice-President S. C. Montgomery who collapsed while driving his car in downtown Calgary on the Monday morning after the meeting.

ECPD Annual Meeting

The twenty-sixth annual meeting of the Engineers' Council for Professional Development was held in St. Louis, Missouri, on October 9 and 10, 1958. The Institute was represented by several members, including two of the three Canadian members of the Council, i.e., W. S. Wilson of Toronto, and G. R. Henderson of Sarnia.

The Institute took a special part in two of the three panel discussions. A group of five from Ontario gave a detailed account of how the Professional Development Program is carried out in Canada. This activity was set up originally by Colonel L. F. Grant, HON. M.E.I.C. and has gone on to success after success. It developed originally from the ECPD program "The First Five Years", but so far as is known no comparable development has taken place in the United States.

The Canadians made an excellent showing under the chairmanship of George L. Schneider, of Hamilton.

The other demonstrators were: J. J. Durand, Toronto, *Development and Objectives;* Jack Walsworth, Jr.E.I.C., Hamilton, *Organization of a Typical Program;* W. J. O'Reilly, Jr.E.I.C., Niagara Falls, *Program Content;* Wm. E. Lardner, Jr.E.I.C., Toronto, *Publicity and Participation.*

The other panel discussion was based on finding a new and "exclusive" word for the profession to replace "engineer". This was an activity of the Committee on Recognition. Panel members were — P. L. Alger, chairman, Ethics Committee, consulting engineer, General Electric Company, Schenectady; L. G. Smith, Guidance Committee, Baltimore Gas and Electric Company, Baltimore; L. Austin Wright, general consultant, The Engineering Institute of Canada; with George H. O'Sullivan presiding, vice-president, J. G. White Engineering Corporation, New York.

This was a most interesting session. After the three panel members had spoken there was a wide discussion from the floor. The outcome was that the audience voted to have the committee continue its work in the hope that a better word would be found.

Another interesting discussion took place at the meeting of the Council, relative to a definition of engineering submitted by the Recognition Committee. Finally the definition was approved and accepted. It is as follows: "Engineering is the (learned) profession in which a knowledge of the mathematical and natural sciences gained by study, experience and practice is applied with judgement to develop ways to utilize economically the materials and forces of nature for the progressive well being of mankind".

A very useful "show" was staged by the Education and Accreditation Committee. With W. L. Everitt, dean of engineering, University of Illinois, presiding, a "mock" accrediting session was demonstrated. Participants were Norman A. Hall, professor of mechanical engineering, Yale, R. G. Folsom, president, Rensselaer Polytechnic Institute, and J. Henry Rushton, professor of chemical engineering, Purdue University. In three acts they showed how accrediting is actually carried out by the committee.

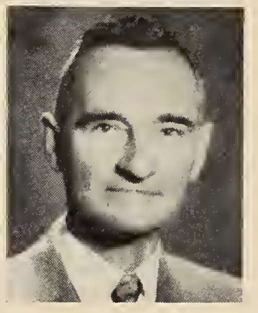
Special speakers for luncheons and dinners were the Hon. Raymond R. Tucker, Mayor of St. Louis, G. A. Hawkins, dean of engineering, Purdue University, Curtis L. Wilson, dean of engineering, Missouri School of Mines and Metallurgy, and Dr. George E. Mowrer, director of guidance, St. Louis Public Schools.

Another matter of interest to the Institute is that ECPD would welcome an invitation to hold their meeting in Canada about 1960 or 1961.

The newly elected officers are: president, W. L. Everitt, dean of engineering, University of Illinois; vice-president, W. L. McCabe, dean of engineering, Polytechnic Institute of Brooklyn.

The Institute's representatives on committees are: Guidance, D. A. Young; Education and Accreditation, C. H. R. Campling; Ethics, J. E. L. Roy; Recognition, Guy Savard and J. C. H. Dessaulles; Information, Garnet T. Page; Planning, L. Austin Wright; Student Development, (under consideration by the Student Development Committee).

Honorary Member



Dr. Armand C. Crepeau, Hon. M.E.I.C.

Dr. Crepeau's photograph was not available for the September issue, Page 118, where the award of E.I.C. honorary memberships in 1958 was reported.

Distinguished Visitors

It is a pleasure to report on two important personalities who were in Montreal during the recent World Power Conference — namely Mr. and Mrs. D. P. R. Cassad of Byramji Town, Nagpur, India.

Mr. Cassad is president of The Institution of Engineers (India) and was their delegate to the Conference of Engineering Institutions of the British Commonwealth held last spring in Australia. Thus it was that Messrs. Anson, Tait and Wright had had the earlier opportunity of meeting him and Mrs. Cassad and of appreciating their outstanding qualifications.

Mr. Cassad is managing director of a group of industrial enterprises in his country. It is interesting to note that in each instance Mrs. Cassad is the president or chairman of the company.

Mrs. Cassad is also a great worker in charity affairs. She is a councillor of Nagpur and is chairman of the municipal committee that deals with all these matters. In Canada, as in Australia, her first interest was to see how Canada handled its federated charities, in particular the care and instruction of the blind, and the care of needy children.

The Institute marked the occasion of the presence of these distinguished people in Montreal in several ways. A luncheon in honour of Mr. Cassad and presided over by our president was given at the University Club, and on another day a luncheon in honour of Mrs. Cassad, and presided over by Mrs. Tupper, was held at the club.

The party was met at the airport and conducted to the hotel by Dr. and Mrs. I. R. Tait and Dr. and Mrs. L. Austin Wright.

The Cassad's were accompanied by two other distinguished visitors from India — Mr. and Mrs. E. A. Nadirshah of Bombay. They were included in all the arrangements that were made for the Cassad's.

It was a pleasant experience to assist in entertaining these charming and important people. Recognition should be made of the important part played in these affairs by Dr. I. R. Tait and Mrs. Tait.

Elections and Transfers

A number of applications were presented for consideration and on the recommendation of the Admissions Committee, the following elections and transfers were effected at the meeting of Council on October 25, 1958:

Members: A. C. R. Albery, London, Eng.; S. G. Barber, Don Mills; H. R. Bohne, Whitehorse; A. F. Branscombe, Montreal; R. J. Braun, Montreal; E. L. Brown, La Tuque; D. E. Coates, Peterborough; A. P. den Engelsen, Montreal; W. H. Edwards, Hamilton; L. V. Frampton, Montreal; P. Gavrin, Montreal; J. A. King, Montreal; R. N. Knapp-Fisher, Weyburn; L. J. Nadeau, Montreal; M. A. Notte, Montreal; J. Pawliw, Peterborough; P. Queneau, New York; T. A. Redmond, Montreal; D. P. Reid, Toronto; R. Scott, Montreal; E. S. Spencer, Toronto; S. A. Stannard, Lauzon.

Juniors: C. V. Aquilina, Montreal; W. G. Brusey, Toronto; F. G. Elkins, Montreal; L. R. Gjertsen, Port Alice; W. Hickinbotham, Orillia; S. A. Kawai, Montreal; P. T. Koltai, Montreal; F. de P. Linares-Gasol, Toronto; J. B. Lowery, Calgary; J. D. Nicholson, Montreal; J. P. Richards, Toronto; S. W. Shishakly, Montreal; P. F. Welling, Hamilton.

Affiliates: T. K. Stephens, Montreal; J. B. Wheeler, Vancouver.

Junior to Member: O. D. Bobyn, Agincourt; K. R. Bullock, Brockville; P. J. Harris, Montreal; N. W. E. Lee, Toronto; C. O. Lockhart, Moncton; J. A. Michell, Hamilton; D. S. Moyer, Toronto; S. Nixon, Trail.

Student to Junior: G. J. Arvisais, Shearwater.

STUDENTS ADMITTED

Royal Military College: A. F. J. Cardin; D. F. Dance; J. G. Delisle; J. G. L. Despatis; J. G. R. Doucet; L. A. Hamilton; W. H. Hatfield; G. W. Hollingshead; N. W. Johnstone; J. S. Klenavic; G. Y. Lafond; N. R. Lee; J. W. Logie; T. H. Marshall; J. A. McCulooch; B. M. Moore; R. Perreault; J. M. R. Prefontaine; S. C. Ross; M. J. M. Ruel; W. H. Sheridan; R. W. Shurb; R. B. Smale; D. B. Smith; V. J. Sokolosky; J. G. Watson; D. E. Weese; B. H. Wilkerson.

University of Toronto: R. Abel; L. P. Drimmel; B. D. Simpkins; K. W. Sparks; E. Suyama; R. K. Watson; W. M. Zacharkiw.

McGill University: M. D. French; D. Gottesman; A. J. MacDowell; M. Papadopol; M. R. Shirlaw; T. P. S. Toor.

University of Manitoba: R. J. M. Bevis; K. A. Biccum; R. W. Glasman; C. D. Holmes; P. J. Keough; C. G. Kunze.

Dalhousie University: I. M. Fraser; D. E. Teed.

Queen's University: J. J. R. Nicholls.

Mount Allison University: J. A. Spargo.

Nova Scotia Technical College: A. D. MacDonald; C. R. Kennedy.

University of Detroit: R. K. Simpson.

C.P.E.Q. Student: K. A. Scholz.

Applications Through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members: L. R. Clark; F. H. McHenry; B. C. Millar; F. J. Ronicker; J. Werner.

Junior: L. R. Thompson.

Junior to Member: D. E. Bateman; J. W. Meagher; N. J. Oneschuk.

SASKATCHEWAN

Members: J. I. Daniels; M. G. Jacoby; M. A. McNichol; T. E. W. Nind; L. P. Williams.

Juniors: L. C. Cole; A. Shklanka; R. W. Stark.

Junior to Member: M. M. Muth; L. A. Parker; P. W. Wright; H. N. Yeomans, L. S. Dillon; C. Zeglinski.

Student to Junior: M. Cherney; H. Schmidt.

NEW BRUNSWICK

Junior to Member: R. B. Brenan.

DID YOU KNOW THAT

The Engineering Institute is the oldest engineering society in Canada, established February 24, 1887, incorporated by the Dominion Act, June 23, 1887, as The Canadian Society of Civil Engineers.

DATES TO REMEMBER

AUGUST 11, 12, 13, 1959

NOVA SCOTIA TECHNICAL COLLEGE

50th Anniversary Reunion

For information write Box 811, Halifax, N.S.

New Periodical Index

Repeated enquiries by the Toronto Public Library have revealed the important role which business and technical periodicals published in Canada are playing in the economic advance of this country and abroad. At the moment a cumulative index to the articles and information appearing in many of these periodicals does not exist.

The Toronto Public Libraries, in consultation with the Canadian Library Association, propose at this time that a further specialized index to other business and technical periodicals be started.

The Toronto Public Libraries will issue in 1959 a bi-monthly index to the articles appearing in the periodicals listed below, and provide an annual cumulation of this index if sufficient orders are received to warrant the cost of publication and distribution.

The index will be prepared by the staff of the Hallam Room of Business and Technology at the Toronto Public Library, and will incorporate the material which is prepared at the present time for users of this section of the Reference Library.

The following Canadian periodicals will be indexed:

Bank of Montreal, Business Review
Bank of Nova Scotia, Monthly Review
C.I.L. Oval
Canada Lumberman
Canadian Bank of Commerce, Monthly Commercial Letter
Canadian Machinery & Manufacturing News
Canadian Mining & Metallurgical Bulletin
Canadian Office
Canadian Oil & Gas Industries
Canadian Personnel & Industrial Relations Journal
Canadian Power Engineer
Canadian Purchasor
Canadian Shipping & Marine Engineering News
Canadian Textile Journal
Canadian Transportation
Chemistry in Canada
Engineering & Contract Record
Engineering Journal
Food in Canada
Imperial Oil Review
Imperial Oilways
Marketing
Modern Power & Engineering
Municipal Utilities
Municipal World
Office Equipment and Methods
Oil in Canada
Plant Administration
Pulp and Paper Magazine of Canada
Trade and Commerce

Businesses, librarians, and individuals are asked to indicate their willingness to subscribe at a cost of $20.00 a year.

Further information may be secured by writing to: Publication Section, Toronto Public Libraries, Toronto 2-B, Canada.

OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Charles Douglas Norton, M.E.I.C., retired engineer of the firm of Aerocrete Construction Limited, Montreal, died in that city on July 16, 1958.

Mr. Norton was born at London, England, on December 19, 1882. He attended the London Polytechnic before moving to Canada in 1901, at the age of nineteen. Mr. Norton lived and worked on different projects in Northern Quebec and Ontario during his first twenty years in Canada. At the outset of his career he gained experience on construction work with the Canadian Pacific Railway. Within a short time he had also worked for the firms of J. S. Metcalfe Company, the Algoma Central Railway, Canadian Northern Railway, and the Mackenzie Mann Company. In 1917 he began an association of several years duration with various mining companies, among them the Canadian Copper Company, British American Nickel, and the Riorden Company.

Moving permanently to Montreal in 1922, he was with the C.P.R. for some time. In the late twenties he began an association with the Fraser Brace Engineering Company Ltd., which was to be renewed in 1940. During the depression years of the nineteen thirties he was with Canadian Industries Limited, the firms of Hans Lunberg, John Stadler, and the Shawinigan Engineering Company Limited. Immediately prior to joining Aerocrete Construction Limited in 1947 he was employed with the Montreal Locomotive Works and the Aluminum Company of Canada. When the Aerocrete company began extensions to the plant it fell to Mr. Norton to take charge of the design of buildings and equipment. At the conclusion of this work he was engaged in the development of new products and continued in this work until the time of his retirement in 1955.

Mr. Norton joined the Institute in 1907, as a Student, transferred to Associate Member in 1915, and to Member in 1940. Mr. Norton attained Life Membership in the Engineering Institute of Canada in 1952.

John Alexander MacGillivray, M.E.I.C., construction engineer with the Ontario Water Resources Commission, died at Willowdale, Ont., on August 23, 1958.

Born at New Glasgow, N.S. on January 7, 1889, he studied engineering for two years at Dalhousie University.

His varied career began in Nova Scotia. It included railroad construction, the duties of construction superintendent on the Halifax reservoir and in 1910 entailed a move to Manitoba to work on the original construction of the Pointe du Bois power plant on the Winnipeg River. Assistant bridge engineer for the Manitoba Good Roads board in 1917 and 1918, he moved on to become resident engineer at Great Falls, Pointe du Bois extension, and the Slave Falls hydro-electric power developments. These projects were on the Winnipeg River, connected with the Abitibi River power plant of the Hollinger Gold Mines.

At a later period he was assistant superintendent and engineer for the greater Winnipeg Sanitary District.

In 1948 he became resident engineer for the Hydro-Electric Power Commission of Ontario at their Des Joachims and later at La Cave, Otto Holden generating stations, on the Ottawa River and the Pine Portage power plant extension on the Nipigon River.

Mr. MacGillivray joined the E.I.C. as a Junior in 1917, became an Associate Member in 1919, Member in 1940 and Life Member in 1957.

Alvin Lawrence Kenneth Malcolm, M.E.I.C., retired field engineer on power development for the Hydro-Electric Power Commission of Ontario, died at Peterborough, Ont., on July 11, 1958.

Born at Galt, Ont., on August 6, 1884, Mr. Malcolm had his early education at Dickson School and the Galt Collegiate Institute. As a 1909 honour graduate from the faculty of applied science and engineering at the University of Toronto Mr. Malcolm joined the consulting engineering firm of Smith, Kerry and Chace, Toronto and worked at Cambellford, Ont. on the Northumberland pulp mill. After two years of work for this firm as an inspector, he returned to the district as assistant engineer on the initial development at Healey Falls, Ont. Later he transferred his services to the Riordon Paper Company, Hawkesbury, Ont., and engaged in preliminary surveys and estimates on the Rouge and Quinze River developments.

In 1916 he accepted an appointment with the Federal Department of the Interior, water power branch, to investigate Bow River, Alta., power possibilities and level regulation on the Lake of the Woods, Ont. About the same time Mr. Malcolm was employed with the Hon. T. A. Low, Renfrew, Ont., in charge of the construction on the control dam and dredging outlet at Golden Lake. The project was taken over by the Ontario Hydro-Electric Commission in 1917 and with the transfer Mr. Malcolm joined the staff of the Commission. This was the beginning of his residency in charge of a long series of power developments throughout the province. During the early years of the 1930's he was engaged in carrying out major maintenance projects. The impact of World War II on the power situation was reflected in the rapid increase in the capacity and number of power projects, involving work at DeCew Falls, Barrett Chute, on the Madawaska, and Des Joachims. Consultant on miscellaneous reports and inspection work at head office in 1949, he was loaned to Defence Construction (1951) Limited, Ottawa, as project Engineer on defence projects in Ontario and Edmonton, two years later after his retirement from the Commission he was retained as consulting project engineer pending completion of these assignments. On many of the Commission's developments Mr. Malcolm served in the dual capacity of resident engineer and construction superintendent.

From his part in the development of power for one of the foremost public utilities in the Dominion, Mr. Malcolm has left a mark of lasting significance in the growth of our country.

He joined the E.I.C. as an Associate member in 1921, transferred to Member in 1940 and to Life Member in 1955.

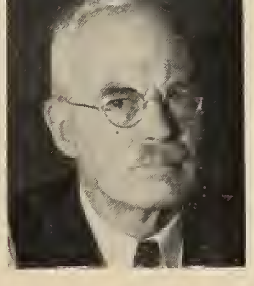
K. W. Bash, M.E.I.C., of Toronto died recently.

Kenower Weimer Bash, was born at Huntington, Indiana, U.S.A., on June 21, 1887. He was awarded a B.Sc. degree in civil engineering from the University of Michigan in 1909. His first professional appointment was with the Canadian Bridge Company, Walkerville, Ont., as draftsman. He worked as engineer and manager of the Maritime Bridge Company Ltd., a subsidiary of the Canadian Bridge Company, 1912-1914, and two years later became engineer, of the Lewis-Hall Iron Works, at Detroit, Mich., and sales and designing engineer of the Whitehead and Kales Iron Works, Detroit. Mr. Bash took charge of the construction department of the Christman Burke Company, Detroit, in 1919, became manager and partner in 1930. After the difficult years of the

(Continued on page 95)

A. L. K. Malcolm, M.E.I.C.

C. D. Norton, M.E.I.C.



NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

QUEBEC

Professional Conduct Post Created

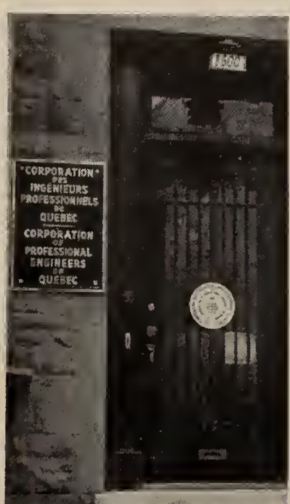
J. P. Dagenais, P. ENG., 36, has been appointed Professional Conduct Officer of the Corporation of Professional Engineers of Quebec, a headquarters post created to better investigate and control unethical or illegal practice of engineering. Mr. Dagenais was formerly combustion sales engineer with the Dominion Bridge Company Ltd., Montreal.

Thoughtful Gift to Corporation

Thanks to the generosity of past-president G. Lorne Wiggs, P.Eng., and that of the Crane Company of Canada Limited, an enamel plaque reproducing in colour the official crest of the Corporation of Professional Engineers of Quebec now adorns the front door of the professional headquarters. The plaque and the name-plate at left, identify in a very dignified manner the home of the Corporation.

American Plans Harmful

Engineering plans and specifications originating in the United States enter into Canada duty-free, unless they pertain to the construction of buildings, in which case they are considered architectural, and are dutiable. Duty on engineering plans was eliminated some years ago with the establishment of Tariff Item 180e. Previously, they had been subject to an import duty of some 20 per cent of the value of the plans.



New plaque improves doorway at C.P.E.Q. headquarters

At various times, representations have been made to have this tariff reimposed, as it was felt that Canadian engineers were not adequately protected. After carrying this item on its agenda for many years, the Canadian Council of Professional Engineers came to the conclusion that it would be necessary to demonstrate that some harm was caused to Canadian industries or to Canadian engineers before any representations to have this duty reimposed could be warranted.

J. P. Dagenais, P.Eng.

Consequently, all members of the Corporation were invited to forward their comments to Leopold M. Nadeau, P.-Eng., secretary-treasurer of the Canadian Council of Professional Engineers. Mr. Nadeau was particularly interested in obtaining actual cases of plans being imported into Canada and causing prejudice to engineers or the Canadian industries and public.

Consulting Engineers' Agreement Forms

Standard forms of agreement between consulting engineers and clients were approved by Council in the summer of 1958 and have since been released, under copyright form, for distribution to the members of the Corporation who are in private practice.

These carefully drafted forms were prepared by members of the committee on consulting practice, but the yeoman's service of Past-President G. Lorne Wiggs, P.Eng., chairman of the committee, deserves special acknowledgment and thanks.

There are three sets of forms: one for architects, and two for ordinary clients; one based on a percentage fee and the other based on a time basis fee, available at a cost of 25 cents.

ALBERTA

(Taken from "The Alberta Professional Engineer," bulletin of the Association of Professional Engineers of Alberta, September 1958 issue)

"The Engineer and His Profession"

A completely new information booklet published by the Association will shortly be coming off the press. This publication entitled "The Engineer and His Profession" has been designed to provide both members and prospective members with a concise account of the aims, purposes and activities of the Association and the Profession of Engineering.

With the extensive expansion of Association membership and activity during recent years, the present information booklet no longer provides an adequate picture of Association affairs. The new publication will supply members with a medium which they can use effectively in promoting the work of the Association. By distribution of the booklet to prospective members, the Association hopes to encourage membership.

"The Engineer and His Profession" represents a two-year task undertaken by the Public Relations committee through a sub-committee headed by Walter Balke. The firm of McConnell, Eastman & Co., our public relations counsel, has organized the information into an attractive format.

Highlights from Council

Council unanimously approved the sponsorship of a Gold Medal in Metallurgical Engineering to be made available in the spring of 1959. Beginning this term the University of Alberta will offer a degree course in metallurgical engineering. The Association will now sponsor a total of seven Gold Medals yearly in the various branches of Engineering.

Mr. L. A. Thorssen, a past president of the Association, and an active committee member, was appointed Association representative on the engineering faculty council, University of Alberta, for 1958-59.

A report was presented on an industrial survey being conducted by the Department of Industries and Labour. The Association co-operated with the Department in preparing data for initiating the survey. The results of the survey should prove helpful in completing a long-term Association plan, as well as in giving an accurate picture of science and applied science personnel employed by the industry in the Province.

ONTARIO

Report on Salaries

(Taken from "The Professional Engineer", the bulletin of the Association of Professional Engineers of Ontario, by T. C. Keefer, field secretary of the A.P.E.O. The article was entitled "A Report on Salaries of Professional Engineers by Levels of Responsibility")

This new report on salaries contained in a booklet mailed to A.P.E.O. members supersedes the "Schedule of Salaries" which was last published in June 1957.

Instead of the former grade definitions, a series of job levels has been defined in the new booklet. The "level descriptions" are more explicit than the old "definitions of grades." Instead of a single salary figure recommended for each grade of the old schedule, representing "equitable remuneration for one performing adequately the duties of that grade", the new booklet reports the median, middle 50 per cent spread, and middle 80 per cent spread of actual salaries paid on July 1, 1958. No recommendations are contained in the new publication. It is, instead, a factual report of salaries paid to 6309 professional engineers by 92 industrial and other organizations in Ontario and Quebec, on July 1, 1958.

While this number of engineers represents more than 25 per cent of the total membership of the Association and the Quebec Corporation, the salary figures reported are believed to be much more representative than indicated by the size of the sample, for this reason.

The organizations participating in the survey were asked to identify professional engineers in their employ who were performing precisely the work specified in a number of job descriptions supplied in a "reporting manual" at the beginning of the survey. They were asked to report the salaries paid all the engineers doing this work, whose positions in addition matched the appropriate responsibility level, but they were also asked to exclude ruthlessly from their reports the salaries of men whose jobs did not meet these two requirements. In respect of each job, therefore, something approaching a "saturation" sample was obtained from all the organizations in the survey.

Since the job descriptions form a series of "bench marks" throughout the hierarchy of engineering, each related to its own level of responsibility, there is no doubt that the process of ranking by job level, which the approach outlined in this new publication involves, can provide professional engineers and their employers with accurate and meaningful information concerning "going rates" for a great variety of engineering positions.

Copies of the job descriptions used in the survey were available upon request.

Most important and perhaps least apparent among the differences between the old publication and the new, is the fact that whereas the former was a compendium of salary information built up by the engineering profession in Canada from its own resources, the latter is the culmination of a co-operative effort extending over the last five years between the Association and industry.

The ninety-two organizations that have engaged with the Association and the Corporation in this work have shown a sincere desire to assist the engineering profession in improving the techniques of salary surveys to a point where these can be entrusted entirely to the professional bodies. It is considered desirable by all concerned that engineers should be given, by their professional governing bodies, the same basic data that is used by their own employers in establishing proper salaries. It is believed that a professional relationship between engineers and their employers is most likely to develop and flourish when the only concern of both parties in the matter of remuneration is likely to be the correctness or otherwise of a man's assignment to a given level of responsibility and his performance within that level in terms of productivity. This is a new departure in industrial relations. It opens new vistas to us all in the matter of professional recognition.

(Continued on page 138)

OBITUARIES *(continued from page 91)*

early thirties he became general superintendent for the Foundation Company of Canada at its Baie Comeau, Que. development in 1936.

He was secretary and manager of the Foundation Company of Ontario, 1938, and superintendent of the building equipment and repair department for Loblaw Grocers Company Ltd., in 1940. Loaned to Wartime Housing Limited, at the request of Federal authorities in World War II, he was assistant to the managing director in charge of construction, later became acting general manager of Wartime Housing Ltd.

Mr. Bash joined the E.I.C. as a Member in 1944.

Jerzy Paszkiewicz, M.E.I.C., structural engineer with the Foundation of Canada Engineering Corporation, Montreal, died in that city on September 6, 1958.

Born in Russia on January 22, 1912, Mr. Paszkiewicz entered the Technical University of Lwow and graduated in 1939 after a period of training at a military officers' school. After World War II, then resident in London, England, he studied civil engineering at Polish University College, London. In 1950 he was awarded an engineering diploma from that institution. He served the firm of J. D. and D. M. Watson, chartered civil engineers, of London, England, as an assistant engineer for a period of six years before moving to Canada in 1956. Mr. Paszkiewicz was in Great Britain engaged in a variety of schemes of sewerage, sewage purification and water supply.

He joined the E.I.C. as a Member on March 1, 1958.

Pierre-Michel Larouche, JR.E.I.C., of the Saguenay Electric Company, Chicoutimi, Que., head of substations and generating stations departments, died on September 17, 1958, after a few months illness at the age of thirty-five.

Mr. Larouche was born at St. Georges de Champlain, Que., on September 29, 1923. While very young he moved with his family to Chicoutimi, Que., attended primary schools and the Chicoutimi Seminary from which institution he graduated with a B.A. degree in 1945. Five years later he was awarded a B.A.Sc., degree in electrical engineering at Laval University. Mr. Larouche worked with the Saguenay Electric Company from the time of his graduation in 1950 until the date of his untimely death.

Mr. Larouche joined the E.I.C. as a student member in 1949, transferred to Junior in 1952.

Jean Valiquet, S.E.I.C., of Ottawa, athlete and engineer, died in a Montreal hospital on December 31, 1957, following a long illness.

Joseph Georges Jean Valiquet was born at Rimouski, Que., on May 11, 1935. He received his elementary education at Garneau School, Ottawa, and later attended the University of Ottawa and McGill University. He was awarded a bachelor of science degree from the University of Ottawa in 1955 and in 1957 graduated in civil engineering with a B.Eng. degree.

As best French Canadian athlete in Eastern Ontario and Quebec, he was in 1953 awarded the Gil O. Julien trophy. The following year Mr. Valiquet was named best athlete at the University of Ottawa.

After his untimely death former classmates turned over to the school a trophy commemorating the champion athlete. Noted as a Canadian tennis-player, he was captain and top scorer of the University inter-collegiate football team, and was outstanding in baseball, softball, rugby, swimming, skiing and badminton.

He joined the E.I.C. as a Student Member in 1954.

Personals

News of the Personal Activities of Members of the Institute

J. H. Mowbray Jones, M.E.I.C., (B.A.Sc. mech., Toronto, 1927), president of the Mersey Paper Company Ltd., Liverpool, N.S., has been named president of Bowater's Newfoundland Pulp and Paper Mills Ltd., Corner Brook, Nfld. Although five hundred miles and a province apart, these separate companies are members of the world-wide Bowater organization. Mr. Jones joined the Mersey Paper Company Ltd., thirty years ago as a resident engineer. He assumed the presidency, while remaining as general manager in July 1958.

R. A. Emerson, M.E.I.C., (B.Sc., civil, Manitoba, 1930), has been named vice-president of the Canadian Pacific Railway Company at Montreal. A third generation C.P.R. employee he has held the office of vice-president of operation and maintenance since 1955.

Mr. Emerson held a number of different appointments with the company in Western Canada from 1935 until his transfer to Montreal in 1948. Since that time he has performed the duties of engineer of track, assistant chief engineer, 1950, and chief engineer, in 1951.

A. G. Asplin, M.E.I.C., (B.Eng., civil, McGill, 1938), of Horton's Steel Works Limited, has been named general manager of the organization. Formerly manager of operations at Fort Erie, Ontario, Mr. Asplin continues as vice-president and director of Horton Steel and brings to his new post 19 years service with the company.

Mr. Asplin is a past chairman of the Niagara Peninsula Branch of the E.I.C., 1949.

R. A. Emerson, M.E.I.C.

R. R. Moffatt, M.E.I.C.

J. H. Mowbray Jones, M.E.I.C.

W. D. Hurst, M.E.I.C., (B.Sc., civil, Manitoba, 1930; C. E., Virginia Polytechnic Institute, 1931), City Engineer of Winnipeg, has been elected president of the 4,000 member American Public Works Association. Mr. Hurst, who has served on the board of directors of the A.P.W.A. since 1955, is the first Canadian to hold this office.

Fraser H. Fargey, M.E.I.C., (B.Sc., elec., Manitoba, 1934), of Brown Boveri (Canada) Limited, was recently named vice-president in charge of sales and secretary of the company. Last year Mr. Forgey became vice-president and sales manager of the organization. He joined Brown Boveri in 1950.

Air Vice Marshal Max M. Hendrick, M.E.I.C. (B.A.sc., mech., Toronto, 1932), Air Member for Technical Services R.-C.A.F., has been named chairman of the Canadian Joint Staff, Washington. As Air Member for Technical Services, Air Vice Marshal Hendrick had responsibility for the design and development of all Air Force equipment and facilities.

R. R. Moffatt, M.E.I.C., formerly superintendent, heavy mills department, Dominion Steel and Coal Corporation Ltd., Sydney, N.S. was recently appointed rolling mill consultant, Dominion Steel and Coal Corporation.

Maurice D'Amours, M.E.I.C., (B.A.Sc., elec., Laval, 1945), of the Quebec Power Company, has been named to the post of general superintendent of the firm. In 1954 Mr. D'Amours took over the duties of superintendent of operations, electrical division, following service in the company dating to his graduation.

Gordon D. Campbell, M.E.I.C., (M.Sc., civil, Man., 1951; Ph.D., Purdue, 1956), has been appointed a director of tech-

A. G. Asplin, M.E.I.C.

M. D'Amours, M.E.I.C.

F. H. Fargey, M.E.I.C.

Air Vice Marshal M. M. Hendricks, M.E.I.C.

G. D. Campbell, M.E.I.C.

• PERSONALS

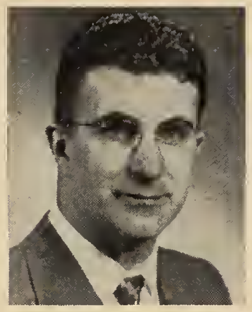
nical services to the staff of the Canadian Good Roads Association. Dr. Campbell was formerly the C.G.R.A. engineer-observer on the $12,000,000 Test Road, constructed in 1956 by the American Association of State Highway officials and the Highway Research Board, at Ottawa, Ill.

Guy Savard, M.E.I.C. (Royal Military College, Kingston, 1937; welding, Ecole Superieure de Soudure Autogene, France, 19), of the Canadian Liquid Air Company Ltd., manager of the technical development department of the firm, has been promoted to manager of the Montreal branch.

Robert S. Morrow, M.E.I.C., (B.Eng., mech., Mount Allison, N.S.T.C., 1950), of the power shovel department, the Maritime Steel and Foundries Limited, New Glasgow, N.S., previously a member of the Branch executive has been elected chairman of the North Nova Scotia Branch of the E.I.C. He has been associated with his present employer since the time of his graduation.

J. E. Pickering, M.E.I.C., (B.Sc., mech., Sask., 1946), has left the services of the Du Pont Company of Canada (1956) Ltd., to join the firm of Babcock, Wilcox and Goldie McCulloch Ltd., Montreal.

R. L. Payer, M.E.I.C.



W. A. Corbett, M.E.I.C.

R. S. Morrow, M.E.I.C.

His new responsibilities are those of sales engineer for the provinces of Quebec, New Brunswick, Prince Edward Island and Newfoundland.

R. Leo Payer, M.E.I.C., (B.Sc., elec., New Brunswick, 1948; M.Sc., elec., 1953), has been appointed manager, electrical apparatus division. Mr. Payer will retain active management of the preformed products division.

William A. Corbett, M.E.I.C. (B.Sc., civil, Man., 1950), of Winnipeg, has been named chief engineer for the consulting engineering firm of Haddin, Davis and Brown (Manitoba) Ltd. Mr. Corbett has had experience in the fields of municipal and structural engineering.

J. E. Pickering, M.E.I.C.

J. C. Kingston, M.E.I.C., (E.M., mining, Colorado School of Mines, 1935), of the St. Lawrence Seaway Authority has joined the Canadian General Electric

Company Ltd., civilian atomic power department, Deep River, Ont. While associated with the Seaway Mr. Kingston's work was that of concrete control engineer. His present duties are those of resident manager, N.P.D. - 2 project.

J. C. Kingston, M.E.I.C.

Major Jack Adams, M.E.I.C.

Major E. C. Ilott, M.E.I.C.

Major E. C. Ilott, M.E.I.C., (B.Sc., elec., London, 1941), has been posted from Fort Churchill, Man., to Winnipeg. While in the North Major Ilott was commanding officer of the No. 18 Company, R.C.E.M.E. At Winnipeg he is deputy command electrical and mechanical engineer of the Prairie Command.

Major **Jack Adams**, M.E.I.C., (B.Sc., mech., Sask., 1944), has been posted from Ottawa to Center Line, Michigan, U.S.A. as Canadian Army Liaison Officer at the Detroit Arsenal. While serving at Canadian Army headquarters Major Adams was chief test officer, vehicle experimental and proving establishment, department of National Defence.

W. Ralph Lewis, M.E.I.C. (BA.Sc. elec., Toronto, 1947), of the electrical engineering department, Dominion Steel and Coal Corporation Ltd. was recently appointed electrical engineer, Contrecoeur project, Dominion Steel and Coal Corporation, in Montreal.

Stanislaw A. Janusz, M.E.I.C., (diploma, mech., Polish University College, London, 1948), has transferred his services as design engineer from the Canadian Westinghouse Company Ltd., motor generating division, Hamilton, Ont., to the atomic energy division of the organization, also at Hamilton.

Correction:
W. F. Allen, M.E.I.C. It was stated in the September issue of the *Journal*, Personals section, that Mr. Allen was employed with the firm of Sherwood Properties Ltd., at Toronto. Mr. Allen has been living in Edmonton, since May 1957, and is chief engineer with the latter firm, earlier known under the name of A. L. Trowbridge & Associates.

George P. Cote, M.E.I.C., (B.A., St. Charles Borromee Seminary; B. Eng., mech., McGill, 1949), has been elected chairman of the Eastern Townships Branch of the E.I.C., for the 1958-1959 term of office.

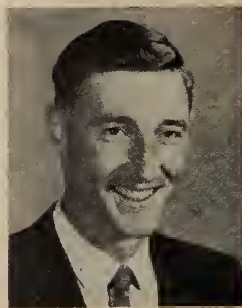
Mr. Cote joined the firm af A. R. Wilson Ltd., Sherbrooke, Que., on graduation. Associated with this firm as vice-president for eight years, he founded

G. P. Cote, M.E.I.C.

with two other engineers the consulting firm of Cote, Leclair and Langlois in 1957. He was vice-chairman of the Branch in 1957.

D. T. Austin, JR.E.I.C., (B.Sc., Queen's 1948, M.Sc., metall., Queen's 1949), chief metallurgist at the Arvida works, Arvida, Que., for the Aluminum Company of Canada, was recently named technical director of the Kingston works of the organization.

H. E. T. North, JR.E.I.C. (B.Sc., Queen's, 1955; D.C. Ae., College of Aeronautics, U.K., 1957), has accepted employment as a sales engineer, with Canadian Pratt and Whitney Aircraft, Ltd., at Montreal. Mr. North recently returned from an Athlone Fellowship in Great Britain.



H. N. Yeomans, JR.E.I.C.

D. C. MacCallum, M.E.I.C.

J. P. Woods, M.E.I.C.

Hugh N. Yeomans, JR.E.I.C. (B.Sc. Civil, Manitoba, 1950), has been appointed senior roads engineer with Underwood, McLellan and Associates Ltd., Saskatoon, Sask. Mr. Yeomans previously served as assistant supervising engineer, highways division, Department of Public Works, Edmonton, Alta.

D. C. MacCallum, M.E.I.C., (B.E., mech., Nova Scotia Technical College, 1949), is the 1958-1959 chairman of the Northern New Brunswick Branch of the E.I.C. Mr. MacCallum, a mill engineer with the New Brunswick International Paper Company at Dalhousie, N.B., has been associated with the organization since his graduation.

Mr. MacCallum was a member of the Branch executive in 1957.

D. T. Austin, JR.E.I.C.

H. E. T. North, JR.E.I.C.

J. R. MacKay, JR.E.I.C.

J. P. Woods, M.E.I.C., (B.Eng., mech., Nova Scotia Technical College, 1942), is chairman of the St. Maurice Valley Branch of the Institute. Mr. Woods is assistant general superintendent of the Laurentide division of the Consolidated Paper Corporation. He was formerly steam plant superintendent and assistant steam plant superintendent.

John R. MacKay, JR.E.I.C., (B.Eng., mech., McGill, 1951), of the Dominion Bridge Company Ltd., Montreal, has been appointed combustion sales engineer for the Eastern division of the firm. Mr. MacKay was previously with the boiler sales department.

Jean Louis Desautels, JR.E.I.C. (B.A.Sc., mech., Toronto, 1951), has returned to Canada from France. Associated with the firm of Defence Construction (1951) Limited, No. 2 (F) Wing, R.C.A.F., Grostenquin (Moselle) France for some time he now serves the Ottawa office of the organization.

R. Bradley, M.E.I.C., (B.Eng. Mech. Nova Scotia Technical College, 1948), formerly assistant master mechanic, heavy mills department, Dominion Iron and Steel Company Ltd., Sydney, was recently appointed assistant superintendent in the same department.

L. J. Bandiera, JR.E.I.C., (B.Sc., Sir George Williams 1949; civil, Queen's, 1951), who has been associated with the Aluminum Company of Canada, Ltd., since 1951, was transferred from Montreal general engineering department to

L. J. Bandiera, JR.E.I.C.

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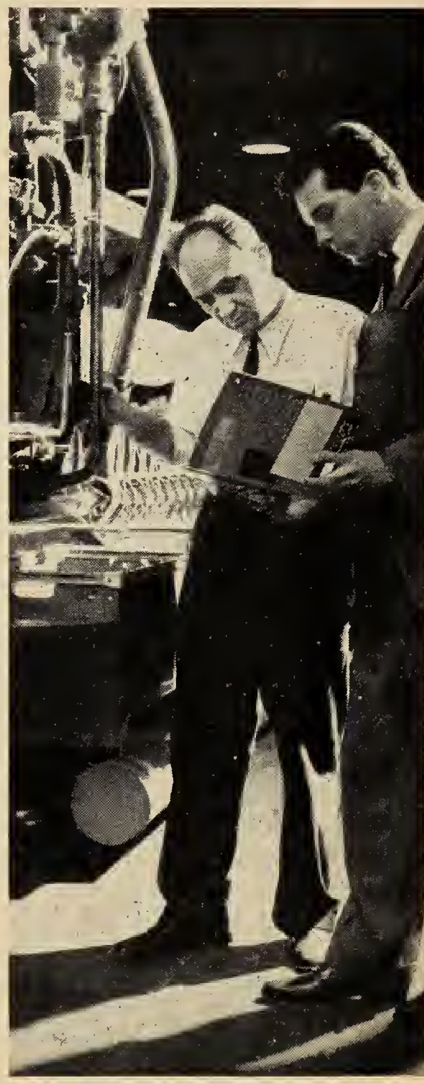

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their Kitimat works engineering department in May 1958. Mr. Bandiera was recently appointed to the post of works engineer for the Kitimat works.

John B. Rea, JR.E.I.C., (B.A.Sc. mech., Toronto 1950), mechanical superintendent of Sprostons (Jamaica) Limited, Kingston, Jamaica, has returned to Canada. He has rejoined the Ford Motor Company of Canada Ltd. at Oakville, Ont. and is temporarily connected with the technical service department. Mr. Rea was earlier associated with the Ford Company in Canada.

J. B. Rea, JR.E.I.C.

Louis Chaumette, S.E.I.C. (Queen's), and Hubert Pilon, S.E.I.C., (B.A.Sc., mech. & elec., Ecole Polytechnique 1958), have been awarded prizes of $150.00 each in the eighth annual Canadian Construction Association competition for theses on construction subjects. Two prizes were awarded because of the excellence of the theses submitted among entries from senior students at seven Canadian universities. Mr. Chaumette's paper was entitled "Serre Poncon Dam," and Mr. Pilon's, "Preparation des Agregats, Bersimis II."

K. E. Plumb, S.E.I.C., (B.A.Sc. mech., Toronto, 1957), of Toronto has left the services of the Canadian Ingersoll-Rand Company Ltd., to join the Toronto Star Limited. In his new work Mr. Plumb is employed with the research and engineering department.

T. A. Brzustowski, S.E.I.C. (B.A.Sc., eng. physics, Toronto, 1958), has been awarded the Air Reduction Company Fellowship in aerochemistry. He is a graduate student in aeronautical engineering, with the Jet propulsion option, at the Forrestal Research Centre, Princeton University, Princeton, N.J. He was an engineer-in-training at Orenda Engines Limited, Malton, Ont., before winning the fellowship.

J. J. Wallace, S.E.I.C. (B.Eng., civil, McGill 1957), formerly with International Nickel Company, Copper Cliff, Ont., has accepted employment with the highways division of the Department of Public Works of Canada, at Edmonton.

NEWS OF THE BRANCHES

Activities of the Fifty Branches of the Institute and abstracts of the papers presented at their meetings

BAIE COMEAU

Norman Lapierre, JR.E.I.C., *Secretary*

G. W. Scott, M.E.I.C.,
Branch News Reporter

A FIELD VISIT to Labrieville, Que., at the invitation of Hydro-Quebec on Friday and Saturday, September 26, 27, began the 1958-1959 winter season of the Baie Comeau Branch.

This was a highly successful and enjoyable outing. Some 142 members and guests attended from Baie Comeau and these were later joined by 9 Labrieville members together with representatives of Hydro-Quebec and construction staff engaged on the Bersimis 1 and Bersimis 2 projects.

The Baie Comeau Party left at mid-day on Friday, 26th September, arriving at Bersimis 2 construction site about 4 p.m. Here work on the various dam sections and 800,000 h.p. power house of the Bersimis 2 Project was in progress. Good weather provided an excellent opportunity for inspection by the visitors.

The tour of the Bersimis 2 construction site was completed by 6 p.m., and thereafter the party went on to Labrieville where the evening's arrangements took the form of a cocktail party, dinner and dance. Brief speeches at the dinner included those of V. M. Wallingford, Branch chairman; J. O. Parker, Hydro-Quebec project coordinator; and J. H. Huggard, resident engineer. A most enjoyable dance followed the dinner.

On Saturday morning, September 27, a conducted tour was made of the Bersimis 1 power station. The eight generators involved in this 1,200,000 h.p. installation are the most powerful of their kind in the world; and although construction was largely complete, it was possible to examine both generators and turbines at various stages of construction. Following the Power House visit a twenty-three mile trip by road was made to the Stage I Desroches and Bersimis dams.

Lunch at Labrieville, as the guests of Quebec-Hydro, terminated the official arrangements and the visitors returned home during the afternoon. The Baie Comeau Branch is much indebted to Quebec-Hydro for this their first field outing and in particular to Mr. J. O. Parker and Mr. J. H. Huggard and their staffs for their hospitality.

A field trip to the Bersimis No. 1 & 2 Power Stations, took Baie Comeau Branch members to Labrieville, Que., on Sept. 26, 27. The four photos here provide a glimpse of the tour. Left: view inside the Bersimis 2 Power station; centre: entrance to the power house, power project No. 2; V. M. Wallingford, chairman of the Baie Comeau Branch; bottom: Baie Comeau visitors viewing the tunnel intake to the Bersimis 2 Power House.

BELLEVILLE

F. E. Moore, M.E.I.C., *Sec.-Treas.*

D. A. Law, JR.E.I.C.,
Branch News Reporter

A PLANT TOUR of the Hinde and Dauche Paper Company at Trenton, Ontario, marked the opening meeting of the season on October 6. Mr. George Boyce, resident manager, briefly described manufacturing processes. Most of the wood used to make cardboard for corrugated boxes is obtained nearby. About 20 per cent of the pulp used consists of scrap paper. The process resembled more an "art" than a "science". It is, however, checked constantly by the chief chemist, Bill Sherisky and assistant, R. Mason.

The tour divided in groups, was conducted by members of the staff of the Hinde and Dauche firm. They were: John Thilson, superintendent, George Bar, boss machine tender, Bob Lane, assistant master mechanic, Howard Langdon, accountant, Frank McCormack, pay master, Bill Sherisky and R. Mason.

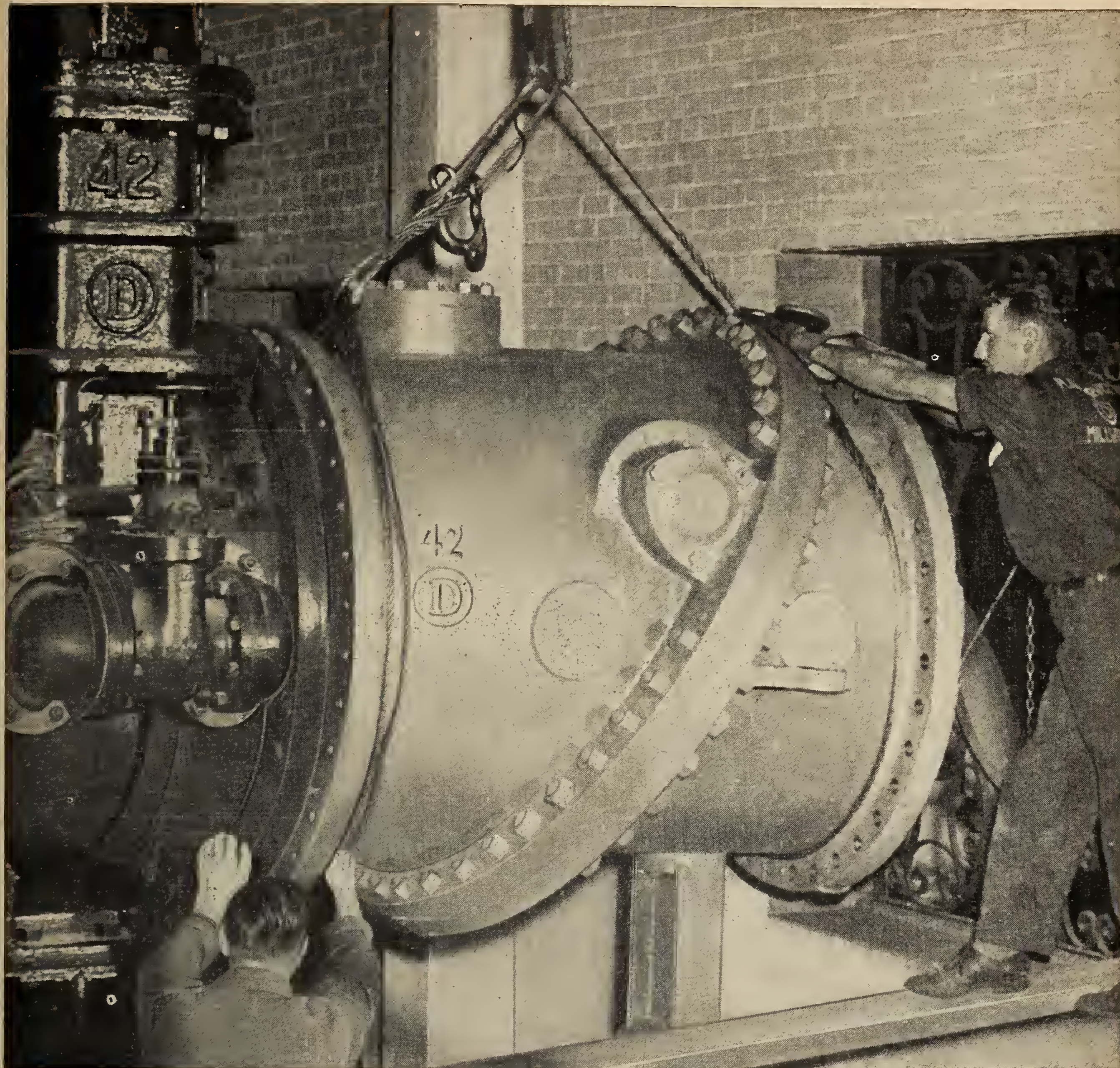
In presenting the thanks of the visiting group, to Mr. Boyce, Branch chairman, T. E. Flinn, pointed out that it was very heartening to find a place of interest so close to home.

CALGARY

O. O. Junker, M.E.I.C., *Secretary*

R. T. Crawford, JR.E.I.C.,
Chairman, P. D. Committee

THE ACE-PROFESSIONAL DEVELOPMENT program, 1958-1959, held annually at the Southern Alberta Jubilee Auditorium began October 15, with a lecture entitled, "The Moslem Faith," by Mr. Usif Hassan, lecturer, Mount Royal College. The talk was the first of a series of five offered with the course, "Religious Philosophies." The second course included



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• BRANCH NEWS

in the Program, "Organization and Function of Government, is also discussed in five lectures. The series for the 1959 session will be published later. Under consideration for the new year are such topics as Canadian culture, music appreciation, and financial control, to mention a few. The ACE - PD program is arranged each year under the sponsorship of the E.I.C. in co-operation with the Canadian Institute of Mining and Metallurgy, and the Alberta Society of Petroleum Geologists. The 1957-1958 program enrollment totalled more than four hundred persons, with an average of two hundred per meeting in attendance. Fees for each course is $5.00 or $15.00 for all the courses in the later 1958 and early 1959 session. Courses will consist of four or more subjects with five speakers for each topic. The 1959 session will open with a social evening, cocktails, dinner and a speaker. Audience participation is planned at all other meetings. Cheques for participants in the Professional Development course are payable to V. Horte, treasurer, ACE - PD program, 401 Natural Gas Building, Calgary.

Annual Barbecue Held

The third annual barbecue of the Calgary Branch was held on September 19 at Colpitt's Ranch and provided the kick-off social event of the fall season. Despite the uncertainties of rapidly changing weather conditions, more than 200 intrepid members and guests were rewarded for a gamble by a clear evening and an unlimited feast of beef, spare-ribs and chicken. An able committee headed by "Nip" Guest provided an excellent evening of fellowship, community song and dancing.

CAPE BRETON

H. M. Aspinall, M.E.I.C., *Secretary*

THE COMMONWEALTH CONFERENCE of Engineers in Australia was discussed by C. M. Anson, immediate past-president, E.I.C., and vice-president and general manager of the Dominion Iron and Steel Company at a meeting held at Sydney September 25.

Mr. Anson used coloured slides to illustrate his account of places visited not only in Australia, but enroute. He described living conditions in Australia, power plant constructional projects, the construction of reservoirs and other related endeavours.

Second item of interest on the program was a group of slides showing the Ripple Rock explosion in British Columbia, observed by Mr. Anson as he returned to Canada.

M. Anson was introduced by M. R. Chappele, building contractor of Sydney, and thanked by Bruce Rossettie, President of the Sydney Engineering and Dry Dock Company.

Three retiring professional engineers, J. E. Underwood, R. A. McLellan, and Dean I. M. Fraser, were honored at a reception given by the Saskatoon section, Saskatchewan Branch, on September 23. They are: back row, l. to r.: W. G. McKay, O. L. Symes, G. O. Handegord, A. Michalenko, R. Peterson, A. F. G. Carroll, R. E. Ludwig. Middle row: C. R. Forsberg, W. E. Lovell, J. A. Wedgwood, A. H. Douglas, W. R. Staples, R. B. Torchinsky, and J. B. Mantle. Front row: H. M. Weir, and the three honored guests, R. A. McLellan, J. E. Underwood, and Dean I. M. Fraser; A. A. Murphy, and E. K. Phillips. *(See page 116 for report.)*

CENTRAL BRITISH COLUMBIA

W. J. M. Owen, *Sec.-Treas.*

A. F. Joplin, M.E.I.C.,
Branch News Reporter

SOIL MECHANICS, with special reference to landslides, was the subject of a paper delivered before the Central British Columbia Branch at its September 26th meeting.

The paper covered a short history of development of study of soil mechanics and a review of books. Particular reference in the talk was made to the "Drynock Slide" which has been a source of trouble to Canadian Pacific Railway since 1894. The slide, a few miles west of Spence's Bridge in the Thompson Canyon must be stabilized to enable completion of Trans Canada Highway. It is estimated some 18,000,000 cubic yards is moving in a "flow" slide. The methods of measuring and controlling to be used were discussed.

Reports were submitted on the erection of memorial cairns at Vernon, Kelowna, Oliver, Penticton and Revelstoke with plaques drawing attention to pioneer engineers and their work. These projects are being handled by local engineers.

The pioneers to be so honoured are: F. H. Latimer, designer of the South Okanagan Land Project Irrigation, Oliver, B.C.; A. H. McCulloch, chief engineer, construction of Kettle Valley, Railway, Penticton; F. B. Groves, designer of major irrigation works at Kelowna; A. E. Ashcroft, designer of the Vernon Irrigation System, Vernon; Major A. B. Rogers, engineer in charge of construction of the C.P.R. through the Rocky mountains, 1880-1885, at Revelstoke. This work is to be completed in 1958 as a part of the Centennial Year of the province of British Columbia.

CORNER BROOK

Eric R. Skanes, JR.E.I.C., *Secretary*

H. A. Hinton, JR.E.I.C.,
Branch News Reporter

COMMUNICATIONS IN NEWFOUNDLAND was the subject of a talk given by F. J. Lounder, plant supervisor for C.N.T., St. John's, Nfld., at the September 24 meeting of the Branch.

Particular reference was made to the microwave system extending from coast to coast in Canada, the Newfoundland portion of which it is expected will be in operation by mid-1959. This will connect Newfoundland with the television network of the C.B.C., and with the existing Telex system of the mainland.

Mr. Lounder also mentioned the con-

siderable expansion of C.N.T. facilities connecting this province with the rest of Canada since the 1949 confederation of Newfoundland with Canada.

HAMILTON

W. A. H. Filer, JR.E.I.C., *Sec.-Treas.*

J. R. Currie, M.E.I.C.,
Branch News Reporter

THE ANNUAL "STAG" party of the Hamilton Branch, a beer and oyster party, was well attended and enjoyed by all. H. E. Seely had charge of arrangements, assisted by P. J. McNally and Casey Jones. The Hamilton Branch extends thanks to Mr. McNally for the generous use of his farm. The yearly social event was held September 25.

The technical section division of the Branch under the chairmanship of M. M. Kennedy, has organized a series of twelve lectures on the subject of Law. Presented by lawyers qualified in each of the specific subjects to be covered, the lectures began on October 6 and are held on the first and third Mondays of each month. A record turnout is indicated.

OTTAWA

W. V. Morris, M.E.I.C., *Sec.-Treas.*

A. H. Graves, S.E.I.C.,
Branch News Reporter

CANADIAN ARSENALS were discussed by Lt.-Col. Serge Stucken, director of Engineering Services, Canadian Arsenals Ltd., before an audience of 70 persons attending the first fall meeting of the Ottawa Branch held at the Chateau Laurier on September 18.

Lt.-Col. Stucken was introduced by John P. Sterling, chief engineer, Defence Construction Ltd. Lt.-Col. Stucken said that research on guided missiles is so expensive that Canada has not embarked extensively in that direction, but has kept up with research in other forms of conventional armament.

During the Korean War, he explained, Canadian Arsenals, with ten plants in Ontario and Quebec, was one of the largest employers of labor in Canada. In 1945, he said, Canadian government Second World War arsenals were grouped together in a Crown company under the name of Canadian Arsenals Ltd.

Colonel Stucken emphasized the fact that the purpose of the company was to supplement Canadian industrial capacity in the armament field.

A number of colored slides illustrating the specialized techniques which require a maximum of precision in operations and used by the Crown company in its work, were shown.

Hector Chaput, Branch chairman, presided at the meeting.

MONTREAL

G. M. Boissoneault, JR.E.I.C.,
Sec.-Treas.

Bernard Lamarre, JR.E.I.C.,
Chairman, Sports Committee

THE ANNUAL GOLF TOURNAMENT organized by the Junior Section for the entire Montreal Branch membership, was held on September 6, at the St. John Golf Club.

There were 101 participants in the tournament. Sixty-one players stayed for the dinner. La Cite de St. Jean graciously offered the wine served during the meal.

Approximately sixty prizes were contributed by various industrial and professional firms interested in the engineering profession. Bertrand Bouchard, won the Layton trophy and the first prize with a low gross score of 77. The other first ten prize winners are the following: 2nd), Robert Payette, 79, gross; 3rd), Dick Middleton, 71.5, net; 4th), Marcel Delage, 83, gross; 5th),

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• BRANCH NEWS

Brian Ozero, 73, net; 6th), C. A. Amirault, 85, gross; 7), Jacques Dubuc, 73, net; 8th), John Turner-Bone, 89, gross; 9th), Jean-Louis Rivest, 73, net; 10th), Louis J. Laflamme, 90, gross.

The sports committee of the Junior Section wishes to thank all participants, gift donors, and others who contributed to make a success of the event.

PETERBOROUGH

J. G. Hooper, M.E.I.C.,
Branch News Reporter

G. M. Locke, JR.E.I.C., *Sec.-Treas.*

THE TELEPHONE INDUSTRY was a subject of discussion by Roy C. Henderson, supervisor of the engineering personnel at the Bell Telephone Company of Canada, in a talk entitled, "A Forward Look in the Telephone Industry."

In outlining the elements of telephone systems he explained that the binary counting system is used in place of the decimal system in telephone work. This makes it convenient to use these bistable devices such as relays in counting and recording telephone numbers. Permanent memories are produced by photographed recorded binary information. Temporary memory devices are in the form of magnetic core lattices. The use of silicon and germanium transistors enables the electronic circuits necessary in telephone work to operate without vacuum tubes with the result that components and the buildings to house them can be much smaller than would be required if tubes were needed. Mr. Henderson described the construction of the Trans-Atlantic telephone cable and explained how the one cable carries telephone conversation controlled channels and telegraph channels. Repeater amplifiers are installed every 37 miles along the cable as it passes under the ocean. Photo-transistors are used in long distance switching equipment which are now in use in Toronto and will eventually be here in Peterborough to permit dialing any number on the continent, from any phone. Photo-transistors are used in selecting the proper route for each call while the number is being dialed. The Telephone Company is installing new equipment in areas where either the old equipment was worn out or where new facilities are required. The crossbar equipment being installed in some areas this year is new, but it is already becoming obsolete with the advent of new electronic switching telephone exchange equipment. New telephone cables that can be either buried or installed on poles are now available. The presently familiar bell in each telephone will be eventually replaced by the tone sounded through the telephone receiver. This allows eliminating the bells and magnets in each telephone set. Small personal radio receivers are being developed to permit all persons to be called by central transmitter whenever they are wanted on the telephone. These are called Page Masters. Bell laboratories have recently developed solar cells to power telephone apparatus from the energy in sunlight. The operation of a transistor radio using the energy of the light from an ordinary electric lamp instead of from conventional batteries was demonstrated. A model of a picture phone was also shown.

SARNIA

R. F. Routledge, M.E.I.C., *Sec.-Treas.*

C. M. Stewart, JR.E.I.C.
Branch News Reporter

INDUSTRIAL SAFETY PROGRAMS, and the progress being made in this field of endeavor was traced by Glen Griffin, director of the National Safety Council, Chicago, Ill., at a recent meeting. In his talk entitled "The Role of the Engineer in Industrial Safety Programs", Mr. Griffin said that efforts were first made to improve working conditions in the plant, to concentrate first on machine guarding, and to rectify other unsatisfactory plant conditions. The present need, he said, emphasizes safe working conditions and the training of personnel in safe working methods. Accidents result from deficiencies in both of these factors, he added.

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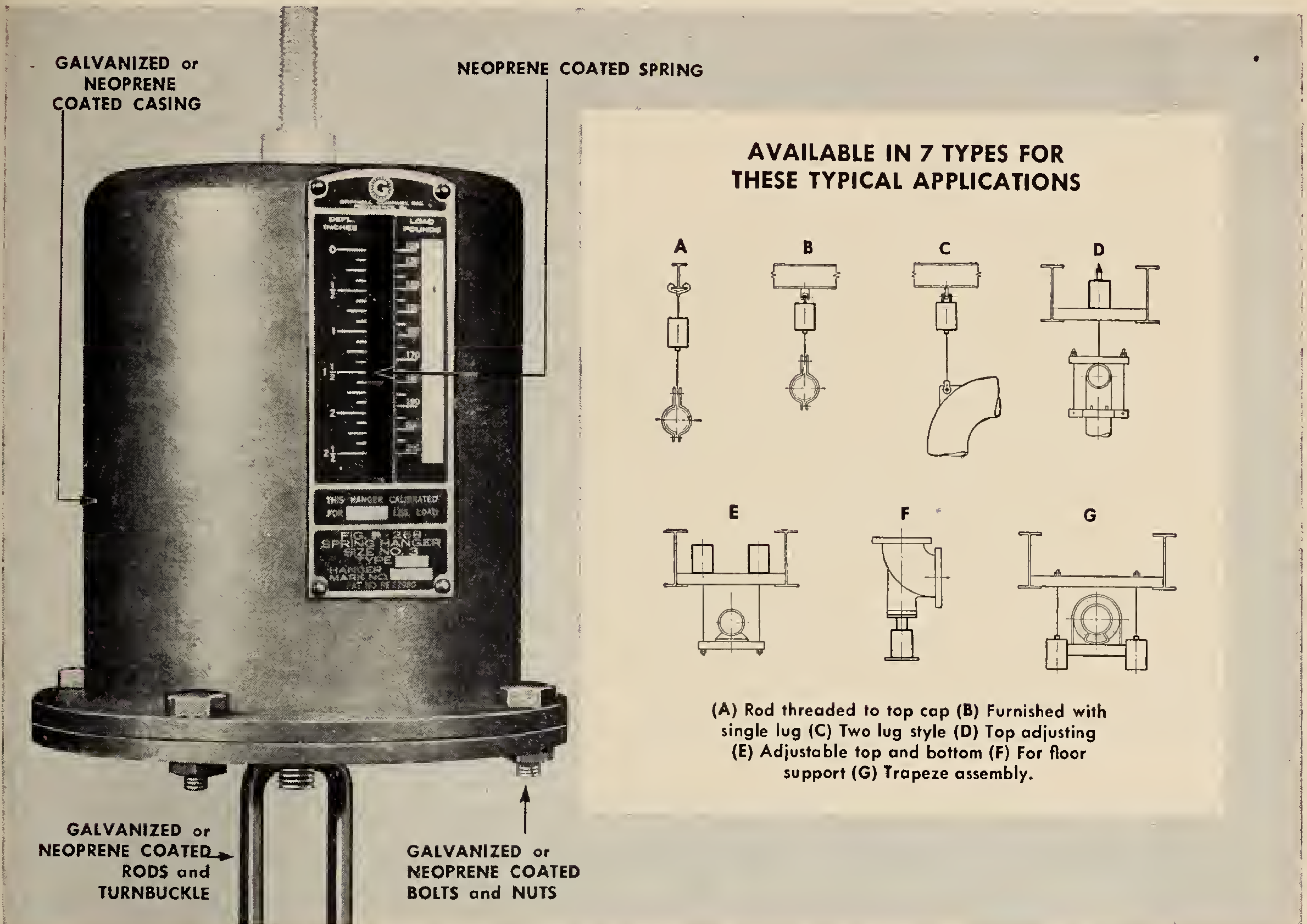

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BRANCH NEWS

To improve the effectiveness of safety programs engineers would do well to assist the vast majority of safety department personnel who are not engineers, Mr. Griffin indicated. Advice on technical matters and the formulation of new safety standards were fields in which engineers could be of considerable help.

In analysis of accidents, and near accidents, the important thing was to establish the cause and to take preventive steps, rather than to point the finger of blame at an individual. Immediate action on safety recommendations is essential. Mr. Griffin was introduced by William Schofield.

Professional Development Course

The Canadian economy in 1958 will be evaluated by the Sarnia Branch this season in an eight-lecture series, from October 2 to November 20. Purpose is to give members an opportunity to become acquainted with certain vital aspects of our Canadian economy. Cost of the course to members is $8.00, for non-members, $12.00. Maximum enrollment was set a fifty.

Featuring top speakers drawn from the ranks of various university department and national interests, the lectures are: The Economics of Full Employment; Wage Policy and Full Employment; Canadian Trade Relations; Dominion-Provincial Financial Relationships; Transportation; the St. Lawrence Seaway; and the Economics of the Canadian Chemical Industry.

SASKATCHEWAN

Roger Dupuis, M.E.I.C.,
Branch News Reporter

R. Bing-Wo, M.E.I.C., *Sec.-Treas.*

THREE BRANCH MEMBERS were honored at a reception given by the Saskatoon section of the Saskatchewan Branch, Sept. 23, marking their resignation from the consulting engineering and educational fields after many years of service. The three gentlemen, J. F. Underwood, and R. A. McLellan of the firm of Underwood, McLellan and Associates, and Dean I. M. Fraser, retiring dean of the college of engineering, University of Saskatchewan were presented with gifts from the Branch.

A review of the careers of the three long-time engineers was presented during the evening.

Dr. B. W. Currie, head of the physics department at the University of Saskatchewan, gave a short talk on experiences gained in Moscow while attending an IGY conference. He cited a number of humorous incidents which befell him behind the Iron Curtain, and entertained the group with his outlook on Russian life.

TORONTO

D. S. Moyer, JR.E.I.C., *Sec.-Treas.*

Sherman Gauley, JR.E.I.C.,
Branch News Reporter

THE ENGINEERING ASPECT of the operation of Orenda Engines Ltd., Malton, Ont., was outlined interestingly by several company spokesmen as an introduction to a plant tour enjoyed by the Toronto Branch, September 25. They were S. L. Britton, chief administrative engineer; C. B. Wrong, chief aerodynamics engineer; D. E. Cram, chief mechanical development engineer, and P. K. Peterson, chief equipment engineer. F. L. Frame performed the duties of host.

In the initial stages the design is controlled by many parameters; some of which are: designed thrust, mass flow, engine diameter, weight, maximum altitude, maximum inlet temperature. From the first design proposal, charges are dictated by practical problems such as machining and materials. Finally the first experimental engine is built.

The work of a development department is to produce failures. The experimental engine is tested in component form, such as a complete compressor, and later as a complete engine. As weaknesses are found in the design, development and design departments work closely together to find the best re-design. The cycle of design, manufacture, test, re-design goes on until the complete engine reaches a satisfactory state of reliability.

● BRANCH NEWS

The equipment needed for testing is very complex and costly. An example is the purchase of the world war II munitions plant at Nobel, Ont., for use as a test facility. The steam turbine was used as a source of shaft h.p. to drive compressor units on test.

To date Orenda has designed three turbo-jet engines. The Chinook, with a 3,000 lbs. thrust, was an experimental engine. The Orenda is an engine of approximately 7,500 lbs. thrust. Over 4,000 have been produced. The Iroquois has a 20,000-lb. thrust without after burner, a higher thrust per lb. of weight than any other known engine. In recent tests in the U.S.A. it produced the highest thrust and ran at the highest inlet temperature recorded on this continent.

VANCOUVER
Ronald Clough, M.E.I.C.,
Secretary

J. J. Kaller, M.E.I.C.,
Publicity Chairman and Branch News Reporter

GEOFFREY F. KENNEDY, M.A., M.I., MECH., M.I., E.E., senior partner of Kennedy and Donkin, consulting engineers, London, England, an outstanding authority in the field of thermal and hydro-electric power stations discussed the famous Owen Falls development in Uganda at the September 25 meeting of the Branch. The particularly well-presented address was followed by a film depicting the construction of the dam and powerhouse.

Annual Ladies' Night

The annual "ladies' night", of the Vancouver Branch was celebrated on October 3, at a dinner-dance, held at the Waldorf Hotel. The Polynesian setting supplied the theme to the whole mood of the evening. Each lady received a beautiful orchid corsage and the dinner jackets of the men were adorned with leis. Even the door prize was a Hawaiian grass skirt and hat.

Wives Association Program—1958

The Engineers' Wives Association of Vancouver and Lower Mainland, British Columbia, have announced the events scheduled for the 1958-1959 season, in a neat black and white printed folder. Membership in the organization is open to the wife or widow of a member, junior, student or affiliate of the E.I.C., and/or The Association of Professional Engineers of British Columbia. Annual fee for membership is $2.00, payable to Mrs. J. J. Kaller, 3862 W. 41st Ave., Vancouver.

First item on the program was a membership tea, at the University Club of Vancouver, on September 25. On October 23, and November 20, a dinner, for husbands and wives at the Delmar, Granville St., with Dr. Desmond Kidd, guest speaker, and, last event of the year, a bridge and tea. Early in 1959, Mrs. Ellen Harris will give an illustrated talk on "A Visit to Japan", in the B.C. Electric Bldg., January 22. On February 20, a dinner dance has been arranged at the Thunderbird Room, North Vancouver. Luncheon at Leon's Cabaret Co. Ltd., with a millinery demonstration by Miss Mollie Entwhistel of Mayfair Hat Shoppe will take place on March 26. A theatre party, April 30, to the Waltz of the Toreadors, at the Vancouver Little Theatre Association. Closing the events for the summer, the annual meeting and luncheon, on May 21. Mrs. A. Peebles will weigh "Comparisons and Contracts: Canada and Europe."

The Engineers' Wives Association officers are as follows: Honorary president, Mrs. J. N. Finlayson; president, Mrs. A. Peebles; vice-president, Mrs. E. S. Pretious; recording secretary, Mrs. T. A. McLaren; corresponding secretary, Mrs. F. G. Pearce; treasurer, Mrs. J. J. Kaller; program, Mrs. L. T. Postle; social, Mrs. K. E. Patrick; membership, Mrs. H. Lillie; hospitality, Mrs. C. D. Bailey; press and publicity, Mrs. D. K. Bannerman; ways and means, Mrs. A. A. Wilson.

News of Other Societies

CGRA Meets at Montreal

The Canadian Good Roads Association held its 39th annual meeting September 30-October 3, 1958 at the Queen Elizabeth Hotel, Montreal, and delegates were welcomed by Lt-Governor Onesime Gagnon, Hon. Antonio Talbot, Quebec Minister of Roads, and His Worship the Hon. Sarto Fournier, Mayor of Montreal. J. T. Douglas, Saskatchewan's Minister of Highways and Transportation was elected president of the Association for 1958/59.

Looking ahead, members foresaw greater use of electronic equipment for computations in road design work and traffic surveys; a trend to much larger and heavier equipment for construction, with giant units up to 34-cubic yard capacity; foam plastic as a base course material, replacing crushed stone and gravel; and plastic membranes for highway subgrades.

The first day's morning session on Tuesday was devoted to presentation of the annual presidential review by the Hon. Hugh Flemming, premier of New Brunswick and president of the Association. He predicted annual expenditures of $2.2 billion on Canada's roads and streets by the year 1973, twice the current total government outlay of $1 billion; and the accompanying increased problems of engineering and administration. He stressed the need for imagination and boldness in dealing with these problems on the part of all those connected with the highway industry.

Mr. Flemming said increased road use and vehicular speeds were "inevitable". He emphasized the need for research in the development of new design criteria and construction materials to accommodate this growing traffic volume and speed.

"The road ahead", the CGRA president said, "points to a bright, challenging and interesting future for all of the people in the highway industry".

Members of the board of directors, the president and first vice-president, Canadian Good Roads Association, appointed at the 39th annual meeting, Montreal, September 29—October 3. Left to right, (front): Norman H. Bell, Hon. F. M. Cass, Minister of Highways, Ontario, first vice-president, C.G.R.A.; Hon. J. T. Douglas, Minister of Highways and Transportation, Saskatchewan, president of C.G.R.A.; Hon. Antonio Talbot, Minister of Roads, Quebec; and A. C. Knight. (back): C. W. Gilchrist, managing director, C.G.R.A.; Frank N. McCallum, Canadian Trucking Association, L. E. Sawyer, R. H. Whiteside, W. B. Flora, A. W. Clark, and J. H. L. Ross.

Roads Roundup

Newfoundland: In the first afternoon session delegates heard reports from each of the ten provinces on construction progress for the year. Deputy Minister C. A. Knight of Newfoundland reported a four-year program for roads other than Trans-Canada had been announced last March, to cost 56 million, and called for 1,200 miles of new construction, 1,700 miles of reconstruction and 600 miles of paving on provincial roads. Contracts had been awarded for 45 miles.

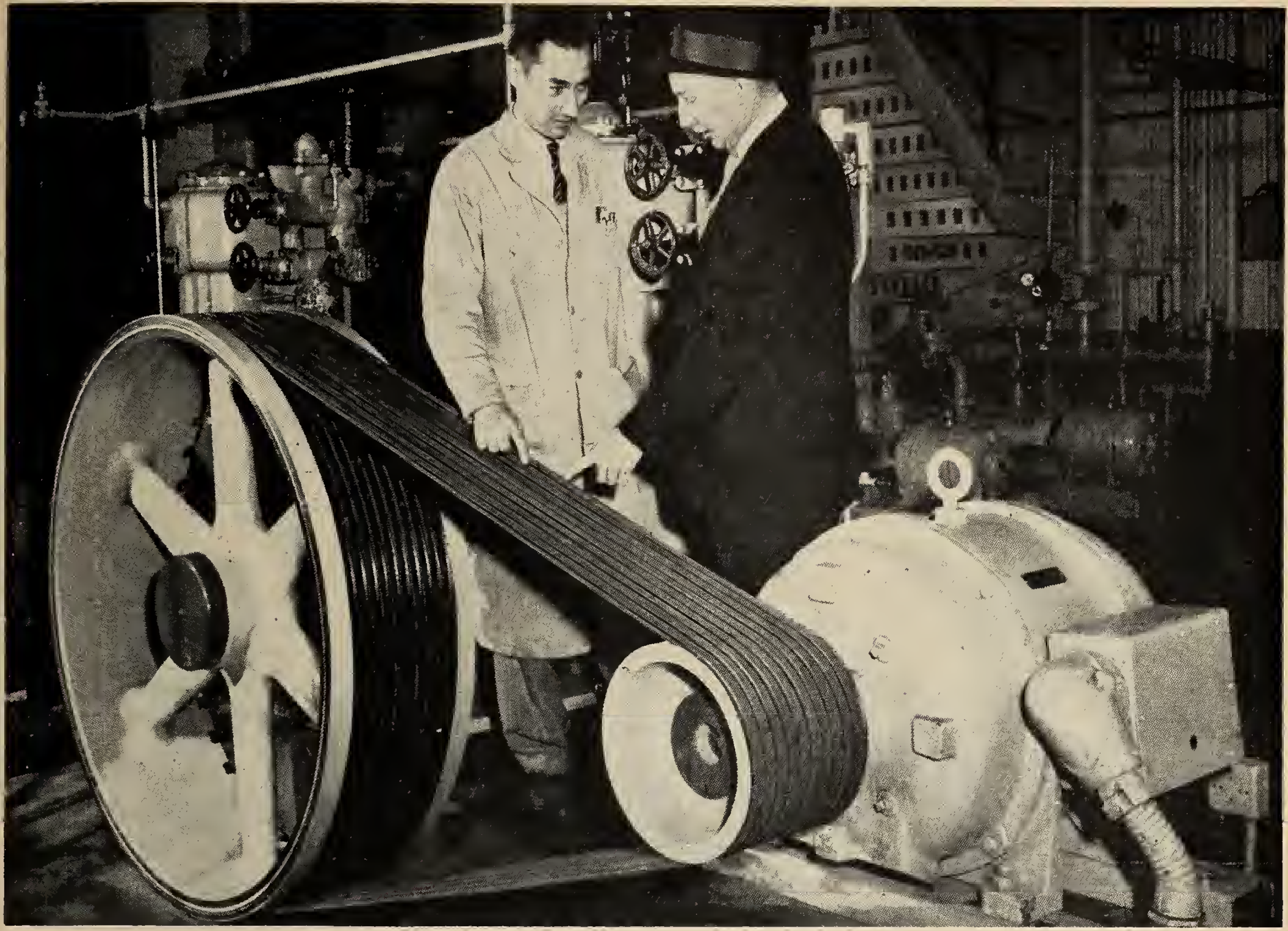
This year expenditure on the Trans-Canada would approach $7½ million, he said, bringing completion of 260 miles of grading and 50 miles of paving out of the province's share of 570 miles of T.C.H. With the opening of the bridge over the Exploits River and completion through Terranova Park early next year, it would be possible to drive from end to end of the province without need of ferries.

Nova Scotia: Highways Deputy Minister, J. L. Wickwire of Nova Scotia reported his province was carrying out its greatest program since 1937, with $20 million earmarked for new road construction and $13 million for maintenance. Work to be done during the year included 78 miles of paving on primary highways, 222 miles paving on secondary highways, and re-paving, 48 miles. Some 285 miles would be prepared for paving. Bridges completed or under construction would total over 200, including 50 of from medium to large size.

Grading and base course for the 10 mile trunk artery to Dartmouth Airport at Halifax was nearing completion, he stated, while the $1 million dam over the Annapolis River was being built. Tenders had been called for a $7 million high level bridge and causeway over the Big Bras d'Or Channel, while a $1 million grade separation at Halifax would be in use by November. Twenty miles of circumferential limited-access highway to serve the Halifax Dartmouth suburban area, to cost $4 million, were being planned.

New Brunswick: Richard Palmer, Deputy Minister of Public Works for New Brunswick, said his province was investing $23½ million on roads and streets in 1958, the largest program in its history. With the $9.9 million from revenue account the total budget for the year would amount to $33.4 million.

In a concentrated effort to complete New Brunswick's unpaved sections of the Trans Canada, $14½ million was being spent this year, said Mr. Palmer. The Province's largest bridge undertaking this year had been the 3,600 ft.



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Grading and gravelling contracts for the year would cover 300 miles, seal coating 600 miles, new pavements, 39 miles, and re-capping and reconditioning, 60 miles, he said. Quebec and New Brunswick jointly are building a $5 million bridge near Campbellton, and a N.B.-Maine and Ottawa joint project would see a $1 million bridge at Campbellton-Lubec.

Prince Edward Island: Deputy Minister of Highways R. G. White of Prince Edward Island told the meeting that $17 million had been budgeted by his province for 1958. The province's 75 mile section of the Trans Canada Highway was only seven miles short of completion. The West River Causeway 1,800 feet long was completed this year. At year-end, P.E.I. would have a total of 3,200 miles, 500 of which were paved.

He reported good progress on planning for the proposed $50 million causeway linking the province to the mainland, which would require some 40 million tons of rock and would take some three to five years to complete. Such a causeway, he said, would mean great savings in transporting marketable goods to and from the island.

Quebec: Arthur Branchaud, chief engineer, Quebec Department of Roads, reported a budget exceeding $100 million has been set in 1958 for the fourth year in succession. With $160 million voted, this was exclusive of a further $22 million for bridges and $30 million for the Laurentian Autoroute, the largest in the province's history. This amounted to $20 more per motor vehicle than the province collected in gasoline taxes, registrations and license fees.

In a summary of current construction projects, he referred to the paving of a 22-mile stretch of highway 58 north of Mont Laurier. Completion of this highway would allow motorists to travel 1,100 miles across the province, from the tip of Gaspé to the Ontario border east of Rouyn, without encountering a single mile of gravel road, he stated. Other major projects included the 560-mile belt-road of the Gaspé Peninsula which will be completed this year, and the linking of Quebec City with the Seven Islands - Baie Comeau extension of Highway 15. Only a gap of 26 miles remains in this $25 million highway project.

Ontario: W. J. Fulton, Ontario's Deputy Minister of Highways, reported his province was in the fourth year of a program which would result in modernization of its entire system of King's Highways by 1970. This year Ontario would spend more than $253 million on its provincial highway system and on subsidies to municipal roads and street authorities, compared with $212.8 million last year. Some 289 capital contracts were scheduled for letting this year, involving 504 miles of grading, 310 miles of paving and 135 structures. The trend of prices paid in the current year had been sharply downward, and the program for the year was well up to schedule.

During the 1958 construction year the Burlington Bay Skyway and another 50 miles on dual-lane controlled access Highway 401 would be completed. Good progress had been made on making the Queen Elizabeth Way Canada's first dual-lane highway. Work had continued on the Ontario section of the Trans Canada, while the Queensway section through Ottawa had shown good progress. Work had also started on the Rainy Lake Causeway east of Fort Frances and eventually the present gap between Fort Frances and Atikokan on Highway 120 would be closed and would then connect the head of the lakes with the proposed Mississippi Parkway.

Authority had been received to accelerate the present program for secondary highways still further, he stated. An additional program had been announced of special large projects which the province will either undertake itself or in co-operation with other highway authorities, in the case of international bridges. This special program could involve an expenditure of $100 million over the next five years and it had been decided to charge nominal tolls on a very few large and expensive bridges. Tolls would first go into effect on the Burlington Bay Skyway, to be officially opened on October 30.

Manitoba: Manitoba's Deputy Highway's Minister, George Collins, reported weather excellent for construction. With a surplus of earth moving equipment, prices had been bid down at least 25 per cent below the 1956 level. Paving and structural prices had remained steady. With a 1958 budget of $35.6 million, the season's program comprised 374 miles of grading, 698 miles of gravelling, 184 miles of base stabilization, 136 miles of prime treatment and calcium chloride, 136 miles of seal coating, 289 miles of bituminous material, and 17 miles of concrete paving.

Manitoba had reached agreement with Ottawa early this summer, in respect to general locations of the joint Northern Development Road Program. Four contracts would be let by October 30th on the route from Simonhouse to the new International Nickel development in the north-west part of the province within the Precambrian Shield, and involved rock equipment and considerable muskeg removal equipment, he stated.

The international connection to the North Dakota portion of the Interstate Highway System was being made at the border towns of Emerson, Manitoba and Pembina, North Dakota. The Trans-Canada would be completed this season, except for a portion of the Metropolitan-Winnipeg Perimeter Route.

Saskatchewan: Saskatchewan's Deputy Minister of Highways, L. T. Holmes, reported excellent weather, no shortages of materials or labor and bid prices somewhat lower than recently. Provision for provincial roads had amounted to $34 million including help for municipalities and northern development. Funds for provincial highways at $25 million were about 11% higher than for 1957. Some 3600 miles of the Municipal Road Grid system would be completed by year-end.

Two large paving contracts would be completed this season on the northern trans-provincial route, he stated, replacing existing surface treatments, and paving had been commenced on the last primary gravel link into the south-central part of the province between Assiniboia and Moose Jaw. The Department was moving into the north-eastern part of the province where there were no cities. This involved paving and dust-control work on highways Nos. 6 and 14. The Roads to Resources program in Saskatchewan was being handled jointly by the Department of National Resources and the Department of Highways, he said. The DNR was working on two roads, one from the Town of Hudson Bay, via the Carrot River to the Manitoba border, destined for The Pas, Manitoba. The other connection to highway No. 55, east of Prince Albert, runs via Nipawin Provincial Park to Flin Flon, Manitoba. The Province had been allocated responsibility for a road into the far north originating on the provincial highway system at La Ronge with a probable destination of Uranium City, and work was now under way.

Alberta: A. M. Paull, chief engineer, Alberta Department of Highways, reported his province had set a budget of $60 million in 1958, divided as follows: Trans Canada Highway $4.8 million; other new roads $30.8 million; bridges, $10.1 million; maintenance $4 million; new district roads, $9 million and for location and surveys $0.62 million.

On the T.C.H., 3.7 miles of grading, 6.25 miles base course, 6.7 miles of concrete paving and 58.7 miles of plant mix surface course would be built. On other new roads there would be 225 miles of grading; 275 miles of sealcoat and 300 miles of gravel surfacing. Bridges would include 10 major, and 24 lesser structures, and replacement of 180 shorter spans.

By year-end, the TCH would be completed except for three miles, he said, while the province would have 132 miles of four lane highways completed. The new Peace River Bridge at Dunvegan would have piers and abutments completed ready for steel erection. It was expected to be open in the fall of 1960. Construction would commence on three bridges at Morrin, Drumheller and Sundre. Two other bridges near Taber and Bonnyville would be commenced.

British Columbia: Deputy Minister H. T. Miard of British Columbia's High-

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ways Department reported. Thirty-four contracts were in progress, 18 of them on the Trans Canada; 53 bridges were under construction. The $20 million Deas Island Tunnel under the Fraser River, and one bridge, were being built by the Toll Authority. Of the total 533 miles of Trans Canada Highway through the province only 63 miles would not be complete or under contract by year's end.

Construction continued on southern trans-provincial by-passes, the Cariboo highway (nearly completed) and the northern transprovincial, he reported. New roads opened in 1958 included the 24 mile Lakelse-Kitimat Highway — The Horseshoe Britannia Beach 21 mile road to Squamish Valley and Garibaldi Park, and the new Elko-Roosville Highway, 23 miles long. The paving program for the year included 120 miles of plant-mix, 42 miles of road mix and 88 miles of sealcoat. Three notable bridges, two of them toll structures, had been opened since the last association meeting.

Federal Highway Program: G. B. Williams, chief engineer, Development Engineering Branch, Federal Public Works, reporting on the Federal highway program, stated federal highway expenditure for the current year was estimated at $115.7 million, of which Public Works was concerned with $83 million exclusive of $15 million for grade separation and $10 million for some 1500 miles of the Northwest Highway System including the Alcan Highway.

Total estimated value of approved Trans Canada Highway projects was $429 million, of which the Federal share was some $256 million, he said. Total length of the T.C.H. including National Park sections is 4,470 miles. At the end of July 2,607 miles had been graded, 1,878 miles had been paved and 255 structures had been completed. There was an additional 1,200 miles of paved road along the route not to T.C.H. standard, which provinces may wish to leave in its present condition.

Through Banff and Yoho National Parks the T.C.H. was complete to the bituminous stage; through Glacier and Revelstoke Parks on the Roger's Pass Route, brushing was practically completed, but it was doubtful if the grading schedule set for the fall of 1959 would be met, he observed. In addition, on behalf of Dept. of Northern Affairs and National Resources, Public Works was undertaking a program of reconstruction of major National Parks highways.

Northern Affairs and National Resources assumes the Federal responsibility for the new Roads to Resources Program, for which Ottawa provides 1½ million per year to each, to be matched on a 50/50 basis by provinces for development of roads, said Mr. Williams. This is a five year program which, if all provinces participate, will call for a federal outlay of $75 million.

Already under construction in the NWT was an extension to the Mackenzie Highway from Alexandra Falls via Fort Rae to Yellowknife and a bridge crossing over the Kakisa River, he reported. Three ferries on major river crossings on the existing Whitehorse-Dawson Road would be replaced with 700 ft. structures.

Addresses and Panel Discussions

On Wednesday morning two addresses were presented relating to construction and maintenance, followed by a panel discussion on specifications, while two addresses were heard on safety education. At the afternoon session two papers were given on soils and materials, followed by a panel discussion on soil compaction. An evening session was devoted to a symposium on frost action, with three papers.

On Thursday morning at a session devoted to roadbuilder's activities, five addresses were presented from regional Road Builder's Associations. In the afternoon session five papers relating to traffic and operations were read, while elsewhere the subject of economics, finance and administration was discussed with presentation of three papers relating to statistics, land acquisition and liquidated damages.

Recalling that the Romans brought their peace and law to the known world by a system of roads, J. B. McGeachy, associate editor of the Financial Post, guest speaker at the Wednesday luncheon, told delegates "the world's greatest headache today is that there is no road between the United States and China by land, air, sea, radio or telepathy . . . It would be a great help to peace if there were such a road now safe, smooth and free, from Paris to Peking . . . There is no peace now without tolerance and no tolerance without roads."

The annual banquet took place on Thursday evening, with the Rt. Hon. John G. Diefenbaker, Prime Minister, as guest speaker. He told delegates and guests that "nothing can help redress the imbalance of northern development Canada has with her neighbouring Arctic communities, more than the construction of roads. A lack of transportation there, more than climate, is the major obstacle to the region's development."

"Alaska is now a state", he said. "Greenland, under Denmark's guidance, is a generation or two ahead of us in development. In Russia, cities of 50,000 persons or more are situated inside the Arctic circle. With its minerals, forests, tourist attractions and strategic position in defence, Canada's great northland is no longer a forbidding land of ice. We want to see a redress of our failure in the past to recognize the north. Canada will spend $100 million on roads in the two territories over the next six or seven years, which will in the forseeable future have provincial status," he added.

H. R. Hawthorne, chairman of the President's Award Committee, presented the President's Medal at the banquet for the best technical paper contributed at the 39th Convention to David L. Townsend, associate professor of engineering at Queen's University, Kingston. His paper, "The Performance and Efficiency of Standard Compacting Equipment" was presented during the panel discussion on soil compaction.

Canadian Chamber of Commerce

Some 700 delegates attended the 29th annual meeting of the Canadian Chamber of Commerce, in Montreal, October 6-7-8, 1958. Discussions developing the theme "Blueprint for Progress" were

A. C. Ashforth

led by R. C. Pybus, M.E.I.C., of Vancouver, who was completing a year in the office of president of the Canadian Chamber.

Delegates represented business and community affairs of wide variety in all parts of the country. The three-day program of the "parliament of business" included plenary sessions on labour-management relations, freedom, foreign trade, and the role of the community Chamber in preparing for tomorrow.

New officers were elected during the meeting. The Canadian Chamber will be led in 1958-59 by Albert C. Ashforth, who assumed the office of president. He is president of the Toronto-Dominion Bank, a resident of Toronto. First and second national vice-presidents are: W. A. Scammell Case, Saint John, N.B., and Herbert Gordon Love, Calgary, Alberta.

The Rt. Hon. The Earl of Home, London, England, Secretary of State for Commonwealth Relations, was the speaker at the annual dinner. He reviewed Commonwealth relations and talked about the general areas of agreement demonstrated by the recent Commonwealth conference in Montreal.

With the recognition of the concept of freedom as a commonly held philosophy, the Montreal conference, he said, found three further objectives attainable. Material betterment could be brought about through this partnership by various means; education would be advanced by current and future plans for study of educational needs; "interdependence"

was the goal, the "secret of progress to be found in constructive co-operation".

Policy of the C.C.C.

In a day of discussion, a series of policy declarations and resolutions of the Canadian Chamber was made ready for presentation to the annual meeting. These resolutions, all national in character and on such subjects as low cost housing, tourism, railway level crossing safety, tarriff rates, government spending, northern development, etc., numbered about 40. They are to form a submission to the Federal Government.

A few of the resolutions are abstracted very briefly, as follows:—

Education: Recommendations favoured active and constructive interest in education on the part of members; establishment of scholarships and endowments, and research programs; co-operation in vocational guidance; encouragement for able students to continue on to higher education.

Automation: Declaration stated that automation is part of the continuing industrial evolution, and an aid to improved productivity; stress was laid on importance of education designed to meet the need for different skills, and more engineers and technicians; gradual utilization of automation would permit retraining or redeployment of the work force.

Material resources: Conservation of soil, water, and forest resources was declared essential; government support was recommended for irrigation schemes which are feasible and economically sound; co-operation of industry, commerce and agriculture was advocated.

Natural resources: Members urged to promote and support federal, provincial and business policies leading to: (1) the properly integrated development of Canada's natural resources in the national interest; (2) resource management that will ensure maintenance and expansion of renewable resources; (3) fiscal and taxation policies consistent with good resource management; and (4) education on conservation and efficient utilization.

Defence: recommendations urged maintenance of defence efforts; re-examination of defence program in view of more expensive weapons of the future; organization of some part of armed forces to assist the civil population to survive a nuclear attack; development of a disaster organization; co-operation with the United States in scientific planning and defence programming and standardization in the production of military equipment.

National highway program: resolutions urged that government of Canada make federal appropriations to provinces for improvement and construction of highways of national significance; that the government sponsor inter-provincial liaison and planning for construction of inter-provincial, development and other highways of national importance.

Ontario Industrial Development Conference

Premier Leslie M. Frost of Ontario addressed a luncheon in Toronto on October 2nd of special interest to over 1,000 municipal officials, business and industrial leaders attending the Ontario Industrial Development Conference. This event, sponsored by the Government's Trade and Industry Branch provided the first opportunity for representatives of municipal government, industrial commissions and planning boards in Ontario to meet with key business executives on such a large scale. The primary purpose was to share specialized knowledge and thinking in relation to industrial development.

Under the chairmanship of Ontario's Director of Trade and Industry, A. V. Crate, this symposium heard opinions from leading Canadian businessmen. Themes of their addresses were as follows:

Herbert Smith, president, Canadian General Electric Company: the need of Canadian industry to develop and manufacture new products suited specifically to Canadian market, and what expanding industry requires from municipalities.

Crawford Gordon, president, A. V. Roe Canada Limited: necessity for Canadian manufacturers to develop their own resources and "brain work" in the area of design research and engineering.

Chairman of Canada's Royal Commission on Economic Prospects, Walter L. Gordon, president of J. D. Woods & Gordon Limited: 'observations and elaboration on specific facets of the Canadian economy related directly to industrial development as revealed through the work of the Royal Commission. Canada's Deputy Minister of Trade and Commerce, John H. English: the outlook, present and future, for industry in Canada and particularly in Ontario.

John S. Proctor, president, Imperial Bank of Canada: the means and problems involved in financing industrial growth.

Mayor Michael Patrick of Windsor, Ontario: local programs to encourage and assist in the expansion of existing industry and in the attraction of new industry.

Eric Beecroft, director, Community Planning Association of Canada: basic community planning and zoning requirements of industry and municipalities.

Stuart D. Armour, Economic adviser, Steel Company of Canada Limited: what government should do for business.

Dr. Edward G. Pleva, University of Western Ontario: transportation requirements of industry, and significance of existing systems of transportation, including the St. Lawrence Seaway.

O. W. Titus, president, Canada Wire and Cable Company Limited: economic and municipal factors to industrial decentralization in Ontario.

Professor Charles E. Hendry, director, School of Social Work, University of Toronto: the impact of modern industry on labour and its families, automation and future social dangers.

Officers

A.S.C.E. Election

Francis S. Friel, of Philadelphia was elected president of the American Society of Civil Engineers at its annual convention on October 15. The new president of the 41,000 member society said that there are many problems ahead for the engineering profession. He cited the need for greater understanding in the fields of guided missile research, traffic and highway engineering, water supply, flood control. Mr. Friel also stated that the social and political implications of all engineering works must be considered as well as the problem of construction.

Human Factors Society of America

Renato Contini, senior research scientist and research coordinator at New York University, college of engineering research division has been elected the first president of the Human Factors Society of America to serve a one-year term. It is an organization of research scientists from government agencies, industrial firms, and educational institutions. It is concerned with the many problems inherent in the man-machine systems. It strives to bring about the best merging of human capacity and machine capacity within the framework of engineering limitations and equipment functions.

Awards

Dr. Frank K. Schoenfeld, vice-president, research, the B.F. Goodrich Company, has been named a recipient of the Industrial Research Institute Medal for 1959. The medal, awarded annually since 1945 honors "outstanding accomplishment in leadership in or management of industrial research which contributes broadly to the development of industry or the public welfare.

Calendar

Illinois Institute of Technology

Industrial Management Engineering Conference, Illinois Institute of Technology, chemical engineering building, 10 W. 33rd Street, Chicago 16, Ill., Feb. 5-6, 1959.

Canadian Construction Association

Meeting, Queen Elizabeth Hotel, Montreal, Jan. 18, 1959.

Institute of the Aeronautical Sciences

Twenty-seventh annual meeting, Sheraton-Astor Hotel, New York. Honors night dinner, January 27, 1958.

Riches from the Untamed Mountains

This is the Rocky Mountain Rift, 500 miles North of Vancouver. With BTH acting as electrical advisers, ambitious plans are in hand to develop this remote, virgin territory for its raw materials and power resources. Present schemes envisage the possibility of the world's largest man-made lake, taking 7 years to fill, and having a hydro-power potential of some 4,000,000 h.p.

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* The largest blast furnace blower of its kind, for the Algoma Steel Corporation.
* Mercury-arc rectifiers, transformers and switchgear for the Canadian British Aluminium Company's Baiecomeau Smelting Plant.

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*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

*CONFERENCE ON EXTREMELY HIGH TEMPERATURES

Represents a summary of the knowledge underlying commercial or usable thermonuclear reactions. Particular emphasis is placed on high temperatures as they relate to the propulsion fields. Covers the production of extremely high temperatures, methods of temperature measurement such as optical radiation, plasma analysis, and applications. The conference, held in 1958, was sponsored by the Electronics Research Directorate, Air Force Cambridge Research Center. (Ed. by H. Fischer and L. C. Mansur. New York, Wiley, 1958. 258p., $9.75.)

*SCIENTIFIC PROGRAMMING IN BUSINESS AND INDUSTRY

The author attempts to present the technique of scientific programming in terms of a mathematical language and understandable by businessmen. An extensive review of the fundamentals of linear programming is given, including the simplex method, the dual theorem, geometry, convex and dynamic programming, and the elements of the theory of games. Specific applications discussed are transportation allocation and production and inventory control. (A. Vazsonyi. New York, Wiley, 1958. 474p., $13.50.)

*LANDING GEAR DESIGN

Throughout the book particular attention is given to practical design advice. It begins with chapters on the purpose and arrangement of landing gear, problems of energy absorption, tires, wheels, and brakes. The general layout and detail design of landing gear are described with information provided on shock absorbers, retraction and stressing. The concluding chapter deals with unorthodox landing gear. This is another in the series of text-books published under the authority of the Royal Aeronautical Society (H. G. Conway. Toronto, Ryerson, 1958. 342p., $11.25.)

ORAL COMMUNICATION OF TECHNICAL INFORMATION

Written to provide a practical guide to effective speaking for technical personnel. The book covers organization of material, composition, delivery of formal and impromptu speeches, and the use of mechanical aids such as recordings and slides. In addition special sections are devoted to presiding at meetings, presenting science to the layman and giving technical legal testimony. (R. S. Casey. New York, Reinhold, 1958. 199p., $4.50.)

*BETRIEBSSICHERE GLEITLAGER

Intended as a manual on the safe and efficient operation of journal bearings, this book covers practical bearing design, lubricants and the basic laws of lubricating films, bearing capacity, heat transmission and operating temperatures, and bearing materials. There is a separate chapter on thrust bearings. The practical aspect of the book is exemplified by the extensive use of tables and graphs for the presentation of technical data. (Georg Vogelpohl. Berlin, Springer-Verlag, 1958. 315p., 46.50 DM.)

*KERBSPANNUNGSLEHRE, 2ND ED.

This thorough development of notch stress theory is devoted to the problem of precise determination of strength and stresses in structural parts. In addition to the technical data interspersed in the text a number of loose folded graphs and diagrams are provided in a pocket at the back for easy use. (H. Neuber. Berlin, Springer-Verlag, 1958. 226p., 36 DM.)

*ZAHNRADER, VOL. II: STIRN- UND KEGELRADER MIT SCHRAGEN ZAHNEN SCHRAUBGETRIEBE

This second volume of a treatise on gear design contains three main sections. The first section deals with spur and bevel gears having helical teeth; the second, with worm gears; the third provides a brief treatment of the measurement of gear characteristics. This new edition covers the developments of the past 20 years and the standards introduced in that period. (A. Schiebel. 4th ed. rev. by W. Lindner. Berlin, Springer-Verlag, 1957. 132p., 21 DM.)

ANALYSIS AND CONTROL OF NONLINEAR SYSTEMS

Developed in a graduate course, this book is intended to provide an account of the available techniques for the analysis and control of nonlinear physical systems. It presents both analytical and topological methods of solving nonlinear differential equations, covering both mechanical vibrations and electric oscillations. Third- and higher-order nonlinear differential equations are thoroughly treated. The author has developed a new approach, based on his method of space trajectory in n dimensions, which extends the phase-plane method to the phase-space.

There is a bibliography of 735 items covering the years 1860 to 1957. (By Y. H. Ku. New York, Ronald, 1958. 360p., $10.00.)

ENGINEERING SURVEYS: ELEMENTARY AND APPLIED, 2ND ED. ENLARGED.

In this new edition of a well-known text-book for undergraduates, the material has been revised and modified where necessary, particularly the chapter on photogrammetry, and the bibliographies have been brought up to date. Sections have also been added on construction problems, modern instruments, and measurements and errors.

THE ENGINEERING INSTITUTE LIBRARY

The publications mentioned in these Notes are now available in the Library. Members of the Institute may borrow books, periodicals, pamphlets, etc. from the Library. The loan period is two weeks, excluding time in transit, and two items may be borrowed at one time. Library hours are: Monday to Friday: 9 a.m. — 5 p.m.; Saturday: 9 a.m. — 12 noon.

Because of a recent change in policy, publications (except periodicals published by other engineering societies) may no longer be purchased through the Library. If members have difficulty obtaining material locally, it is suggested they write to the Library, and the enquiry will be forwarded to an appropriate bookseller. For further information write to the Librarian.

• LIBRARY NOTES

The first eighteen chapters, the Elementary section, are also available in a separate publication. (H. Rubey, G. E. Lommel and M. W. Todd. Galt, Brett-Macmillan, 1958. 916p., $6.75).

MULTIPLE PURPOSE RIVER DEVELOPMENT

The development of water resources involves many disciplines in addition to engineering. This volume provides an economic view of the subject, and a framework for the economic analysis of river system development. The authors consider the conditions required to achieve economic efficiency in water development, and analyse the differences in the pattern of income distribution arising from different policies.

In the second part of the book, case studies of Hells Canyon, the Alabama-Coosa River, and the Willamette River are used to illustrate the economic analysis, and the problem of achieving economically efficient river-basin development. (J. V. Krutilla and O. Eckstein. Baltimore, John Hopkins, 1958. 301p., $6.25).

ELEMENTARY ENGINEERING SCIENCE, 4TH ED.

An elementary textbook brought up to date and largely rewritten, this fourth edition covers the Mechanics, Heat and Electricity sections in Science of the English General Certificate of Education. The M.K.S. system of units has been used throughout, and chapters have been added on velocity and acceleration, expansion of solids, liquids and gases, primary and secondary cells, and the magnetic circuit. Many worked examples, and problems and answers are included. (A. Morley and E. Hughes. Toronto, Longmans Green, 1957. 381p., $2.10).

SPACE FLIGHT AND SATELLITE VEHICLES

Intended for the reader with some basic scientific knowledge, this volume presents a survey of past developments, and an assessment of the future of interplanetary flight. The authors consider the basic principles and methods of achieving space flight, the position in 1957, the prospects for the immediate future, and the uses of satellites. A brief excursion into the far future is also made. Bibliographies are included. (R. B. Beard and A. C. Rotherham. Toronto, British Book Service, 1957. 150p., $3.50.).

PROBLEMS IN ELECTRONICS WITH SOLUTIONS

The problems in this volume cover most of the undergraduate syllabus in electronics, and should prove useful to both lecturers and students. The 282 problems are divided into twenty-three chapters covering circuits, valves, amplifiers, oscillators, modulation, photoelectricity, transmission lines, etc.

The answers are given with the problems, and the solutions are given separately. (F. A. Benson. London, Spon, 1958. 219p., 36/–.).

IMPEDANCE MATCHING

A basic treatment of this important topic intended for design engineers, technicians and students. It covers impedance matching and power transfer, impedance matching devices, and impedance matching at audio frequencies, at radio frequencies and in transistor circuits. (Ed. by A. Schure. New York, Rider, 1958. 119p., $2.90.).

DOCK AND HARBOUR ENGINEERING VOL. 1: THE DESIGN OF DOCKS

The first volume of this set deals specifically with the design of docks. Beginning with the general principles of design and with descriptions of typical dock layouts, it continues with dock and wharf walls; entrances and locks; graving docks, floating docks, and slipways; lock gates and caissons. This work is a revision of two earlier works by Brysson Cunningham entitled "Dock Engineering" and "Harbour Engineering". It is fully illustrated, references are listed after each chapter, and there is a detailed index. (H. F. Cornick. London, Griffin, 1958. 316p., £5.5s.).

COAL AND STEEL IN WESTERN EUROPE

A history of the iron and steel industry in Western Europe, and its relation to the coal mining industry, covering the last two hundred and fifty years.

The first part of the book covers the origins of the modern industry in the eighteenth century when there were many small ironworks and the mining of coal was beginning to be of importance. In the second part the growth of the industries in the nineteenth century is traced in Belgium, France, Lorraine, Luxembourg, the Saar and Germany. The third part shows how in more recent times the production of iron and steel has become concentrated in a small number of very large works owned by a few companies, centred in the European Coal and Steel Community.

The authors, a geographer and an economist, have drawn on many original sources in the preparation of this most useful and readable survey. (N. J. G. Pounds and W. N. Parker. Toronto, British Book Service, 1957. 381p., $9.00.).

GEOGRAPHY AND PLANNING

Although applying particularly to the United Kingdom, this book will prove interesting to all those interested in regional planning and the optimum use of all available land. The author, a Reader in economic geography, discusses the geographical basis of planning, considering physical features, climate and weather, rural and land use, town growth, problems connected with industrial location. A useful bibliography is included. (T. W. Freeman. New York, Rinehart, 1958. 191p., $1.50.).

THREE DIMENSIONAL DYNAMICS: A VECTORIAL TREATMENT

Intended for honour students in mathematics, this volume presents a vectorial treatment of the three-dimensional motion of a particle and a rigid body. Tensors are omitted as they are not considered vital to the study. Among the topics covered are vector algebra; motion of a particle; kinematical motion of a rigid body; theory of rotating axes; moments of inertia; equations of motion of a rigid body; Euler's equations; precessional and impulsive motion. Three dimensional statics are covered in an appendix. (C. E. Easthope. Toronto, Butterworth, 1958. 277p., $7.80.).

AUSTRALIAN RAINFALL AND RUN-OFF

This first report prepared by the Stormwater Standards Committee of the Institution of Engineers, Australia, which was established in 1950, presents information on the intensity, frequency and duration of rainfall in Australia. In the second part of the report methods are given for flood estimation, and for the design of urban drainage. These are considered under the headings of urban storm drainage systems; flat areas, such as aerodromes; minor and major structures of rural catchments. The book is well illustrated with many graphs, tables and maps, and there is a useful bibliography on drainage and floods. (Institution of Engineers, Australia, Stormwater Standards Committee. Sydney, The Institution, 1958. irreg. paging, mimeog., £A2.10.0.).

*INTANGIBLE REWARDS FOR ENGINEERS AND SCIENTISTS, ADMINISTRATION OF SALARIES

Two surveys devoted to the needs, goals, and job satisfaction of engineers and scientists. Specific aspects investigated are job activities, actions of immediate supervisors, salaries, intangible rewards, working relations with associates, company assistance to professional development, attitudes towards collective bargaining, and the administration of technical programs. The surveys are Reports numbers 8 and 9 of The University of Michigan Bureau of Industrial Relations. (J. W. Riegel. Ann Arbor, Bureau of Industrial Relations, University of Michigan, 1958. 1st report 105p., $3.50. 2nd report 84p., $2.50. Bound tog. $6.00.).

LIGHT VISIBLE AND INVISIBLE

In this volume translated from the German, the author sums up modern knowledge of the nature and behaviour of light, and shows how the knowledge has been obtained, and how it is used. He explains how visible and invisible light makes photographs in the dark, weighs and measures stars, opens doors, and cooks food. He explains infrared photography, ultra-violet rays, the telescope, the microscope, x-rays, why the sky is blue, and the colour vision of bees. There are many illustrations. (Eduard Ruechardt. Ann Arbor, Univ. of Michigan Press, Toronto, Ambassador, 1958. 201p., $6.00.).

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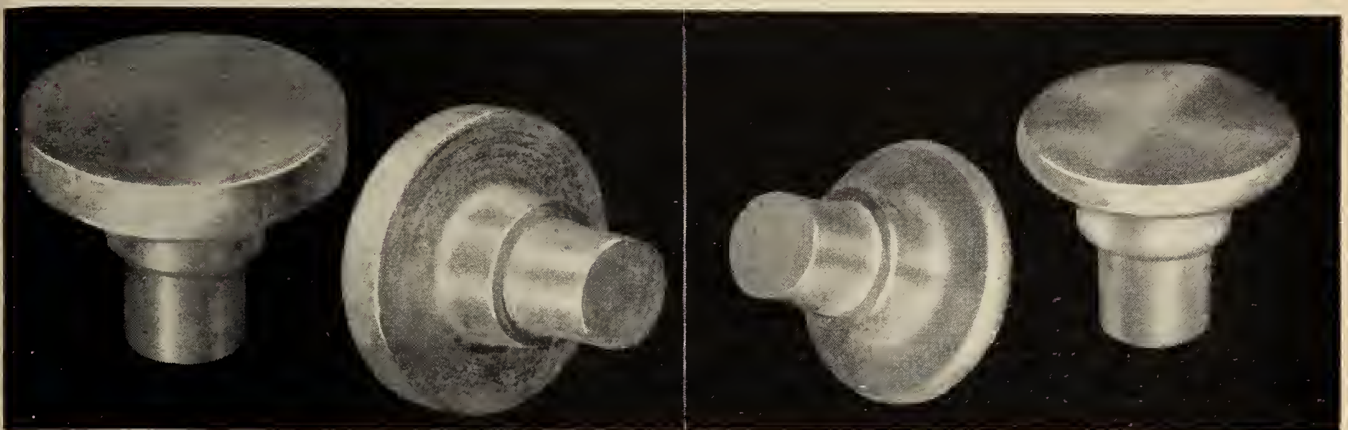

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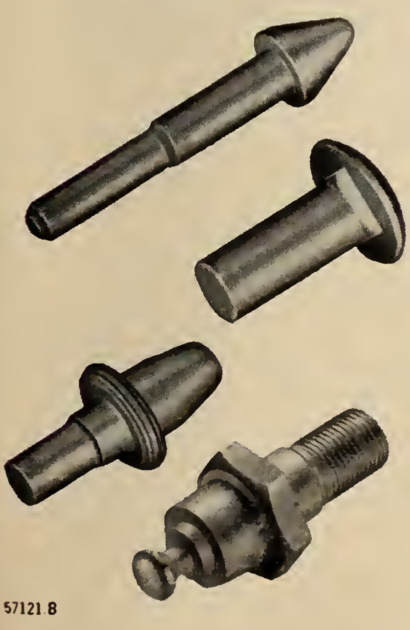

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SECOND — Stelco will carry as stock items your long-run repetitive "specials" — giving you a ready source of supply and the benefit of large-quantity prices.

THIRD — Your "special" requirement might already be in stock as a Stelco "Standard" — or possibly an existing "special" could meet your needs. In either case you would realise a saving.

Why not ask Stelco's Engineers to examine *your* "specials"? If they are adaptable to production by the cold heading process your cost reductions will be substantial. Any Stelco Sales Office is at your service.

THE STEEL COMPANY OF CANADA, LIMITED

Executive Offices: Hamilton and Montreal

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machinery, it commences with an introduction to the hydraulic system and the problem of systematic maintenance. Other chapters cover pipework and oil-tanks; hydraulic fluids; hydraulic seals; the diagnosis and cure of faults. Much of the material is presented in tubular form, and a set of fault-finding charts is included. (Toronto, Longmans, Green, 1958. 124p., $3.60.).

MANUAL OF SCIENTIFIC RUSSIAN

The author has had considerable experience in teaching Russian to scientists, and has based this manual on the experience he has gained. The emphasis throughout is on scientific vocabulary and texts, and on the written rather than the spoken word. The Manual can be used both as a textbook and as a reference book on the structure of the Russian language. (T. F. Magner. Minneapolis, Burgess, 1958. 101p., $4.60.).

CANADIAN TRADE INDEX 1958

Invaluable to purchasing agents, businessmen, and anyone wanting to obtain a product from a Canadian source, this 1958 edition of the Canadian Trade Index lists the names and addresses of over 10,000 Canadian manufacturers and their products. The larger part of the book is, as usual, a classified directory, with a French glossary. (Toronto, Canadian Manufacturers' Association, 1958. 1083p., $10.00.).

TRAFFIC DESIGN OF PARKING GARAGES, REV. ED.

The changes and advances in parking garages since this book was first published ten years ago have led to its publication in this revised edition. The factors influencing design which are discussed include method of operation, parking demand, peak loads, daily loads, seasonal variations, etc., garage location, delivery time, traffic, etc. Various types of floor design and layout and ramp design, are considered as are mechanical garages and various miscellaneous features such as heating and operational techniques. With the present emphasis on off-street parking in our cities, this should prove a most useful book. (E. R. Ricker. Saugatuck, Conn., Eno Foundation, 1957. 168p.)

*CONFORMAL TRANSFORMATIONS IN ELECTRICAL ENGINEERING

Preliminary material on the elements of field theory and of complex numbers is followed by transformations in the order of increasing complexity. The second half of the book deals with transformations involving elliptic functions. Emphasis is placed on the application of transformations to engineering problems. (W. J. Gibbs. Toronto, Ryerson, 1958. 219p., $9.00.)

*PRE-STRESSED CONCRETE: THEORY AND DESIGN

Divided into three parts, the first of which deals with the theory underlying prestressed concrete. Part two covers the design of simply supported beams. Part three gives an introduction to the specialized types of prestressed structures such as composite construction, statically determinate structures, indeterminate structures, liquid-retaining structures, and domes and shells. (R. H. Evans and E. W. Bennett. Toronto, Ryerson, 1958. 294p., $12.00.)

PHOTOSENSITORS

The author has coined the word "photosensitor" to denote any type of photoelectric element, that is for vacuous or gas-filled photo-cells, photo-e.m.f. cells, photolytic cells, and light sensitive resistors. In this treatise the various types of photocell and their applications to industry are discussed.

The first part of the book describes the characteristics of photosensitors, their associated circuits and optical equipment, while the second part examines their application in protective devices, colorimetry, counting devices, door openers, synchronizers, timing devices, etc. There are also chapters on relays and installation and maintenance. A lengthy bibliography and list of patents are included. (W. Summer. Toronto, Ryerson, 1957. 675p., $21.00.)

SALES AND ENGINEERING REPRESENTATION

The sales and engineering representative is becoming increasingly important in modern industrial marketing. This volume discusses the origin of sales and engineering representation, its functions, advantages and disadvantages, the people working in the field, the qualities necessary for success, and the future of the field. It considers ways of getting started, relations with clients, salesmanship, and agency policy. A biblography adds to the usefulness of this interesting and informative book (L. O. Thayer and G. E. Harris. Toronto, McGraw-Hill, 1958. 210p., $6.90.)

*THE SOLID STATE FOR ENGINEERS

Intended to acquaint engineers with the basic principles underlying the behavior of solid materials. Aspects discussed are crystallography; thermodynamic stability of solid structures and rates of change between states; types of solids: metallic, ionic, covalent and molecular; elastic and plastic deformation; mechanical properties of solids; electron and zone theories; electronic conduction, semi-conduction, and insulation phenomena; optical properties of solids. (M. J. Sinnott. New York, Wiley, 1958. 522p., $12.50.)

*MEDICAL ELECTRICAL EQUIPMENT

An introductory section on the uses of electricity in hospitals and the safeguards necessary is followed by sections on various types of equipment, including shadowless light fittings for the operating theatre, emergency lighting systems, x-ray apparatus, radioisotope diagnostic instruments, surgical diathermy, endoscopes, electrocardiographs, electroencephalographs, respiratory and suction apparatus, incubators, and sterilizers. The book concludes with a discussion of small electric motors used in medical equipment. (Edited by R. E. Molloy. New York, Philosophical Library, 1958. 312p., $15.00.)

*MICROWAVE TRANSMISSION DESIGN DATA

Preliminary material is given on general transmission line theory and on coaxial lines and flexible cables. This is followed by a discussion of wave guides with particular emphasis on practical structures and components; dielectric materials and their properties at microwave frequencies; cavity resonators. A reprint of a book

that has been unavailable for some time. (T. Moreno. New York, Dover, Toronto, McClelland and Stewart, 1958. 248p., $1.50.)

*PUMPS, FANS, AND COMPRESSORS

A discussion of the phenomena of flow and of energy transformations is presented prior to the problem of design and construction which comprises the main portion of the volume. Rather than relying on mathematical formulae the authors have stressed experimental results as a basis for the calculation of dimensions for centrifugal and axial-flow fans, pumps, and compressors for various operational requirements. Translated from the original French edition published in 1953. (A. de Kovats and G. Desmur, Glasgow, Blackie, 1958. 327p., 45/—.)

*FEEDBACK THEORY AND ITS APPLICATIONS

Presents methods of linear and non-linear system analysis. The book begins with a discussion of the properties of feedback, particularly with reference to negative feedback and to stability. It continues with applications of the theory of electronic circuits such as the d.c. coupled virtual earth amplifier, the synthesis of stabilizing networks, and to servomechanism. Additional chapters are devoted to non-linear analytical techniques, control systems employing on-off elements and electronic analogue simulators. (P. H. Hammond. Toronto, British Book Service, 1958. 348p., $7.50.)

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Atomic Energy

The A.B.C. of atomic energy, by Sir C. Hinton. London, B.B.C., 1958.

Bridges

Studies in composite design of steel beam and concrete bridge decks. U.S., Highway Research Board, 1958. (Bul. 174).

Cement and Concrete

Cement and concrete, 1958. (ASTM S.T.P. No. 205).

Danish National Institute of Building Research, Committee on alkali reactions in concrete. Progress reports:
F 1, 2 & 3: The alkali content of Danish cements, by E. V. Meyer; A new Danish alkali-resistant cement, by E. V. Meyer; Methods for the determination of alkalis in aggregate and concrete, by J. Andersen and L. Ditlevsen.
I 1: Investigations of Danish aggregates at the building research station Garston, England, by F. E. Jones.

Electrical engineering

Electrical Research Association; Annual report: 37th, 1957. Technical reports: D/T 105—The effect of circuit resistance on the discharge energy required for the ignition of methane-air mixtures, by H. G. Riddlestone. L/T 263—Effect of the cathode material on the breakdown strength of amorphous dielectrics, by J. J. O'Dwyer. L/T 331—The electron emission at the cathode of a cold arc, by A. E. Robson. L/T 355—The dielectric properties of nylon, by E. Rushton and G. Russell. T/T 52—An investigation into the laws relating to the rate of wear and change of friction with the number of revolutions performed in meter type bearings, by G. F. Shotter and G. F. Tagg. Y/T 14—The effect on electricity consumption of the layout of coal-electric water-heating systems, by M. V. Griffith.
Single sideband for the radio amateur. 2d ed. Hartford, American Radio Relay League, 1958.

Geodesy

Review of geodetic and mapping possibilities. Frankfurt, Cooperative Society for geodesy and cartography, 1958.

Industrial Management

Management in the Soviet Union. Princeton University, Industrial Relations Section, 1958. (Selected references, no. 81).
The gap between spendable earnings and labour costs—a growing challenge to personnel administration, by M. T. Wermel and G. M. Beldeman.
The outlook for labour costs in local governments, by M. T. Wermel. Pasadena, California Institute of Technology, Industrial Relations Section, 1958. (BIRC Publications no. 9 and 8)

Logic

101 puzzles in thought and logic, by C. R. Wylie. New York, Dover, 1957.

Metal Properties

Thermal properties of thirteen metals, by C. F. Lucks and H. W. Deem. 1958. (ASTM STP no. 227).
Symposium on large fatigue testing machines and their results. ASTM, 1958. (ASTM STP no. 216).

Meteorology

Climatological summary Isachsen, N.W.T. Canada. Canada, Dept. of Transport, Meteorological Branch, 1958.

Minerals

The industrial minerals of Newfoundland, by G. F. Carr. Canada, Dept. of Mines and Technical Surveys, 1958. (Mines Branch no. 855)
Zinc in Canada with comments on world conditions, by R. E. Neelands and D. B. Fraser. Canada, Dept. of Mines and Technical Surveys, Mines branch, 1958. (Memorandum Series no. 137).

Motor Vehicles

Motor vehicle exercises in calculation, by H. G. Miles and L. W. F. Elen. London, Cleaver-Hume, 1958.

Soil Mechanics

Analyses of soil foundation studies. U.S., Highway Research Board, 1958. (Bul. 173).
Proceedings of the eleventh Canadian soil mechanics conference December 1957. Canada, N.R.C., Associate Committee on Soil and Snow Mechanics, 1958. (Technical memorandum no. 53).

Town Planning

Esterhazy — the potash town plans its development. Regina, Dept. of Municipal Affairs, 1958.

Water

Your most important raw material, by E. P. Partridge. ASTM, 1958. (Edgar Marburg Lecture, 1957).

Welding

The first ten years. Toronto, Canadian Welding Bureau, 1958.

SEE TRANE INSIDE FRONT COVER

STANDARDS RECEIVED

ASTM standards. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

ASTM specifications for steel piping materials.

American Welding Society standards. American Welding Society, 33 West 39th St., New York 18, N.Y.

A6.1-58: Recommended safe practices for inert-gas metal-arc welding.

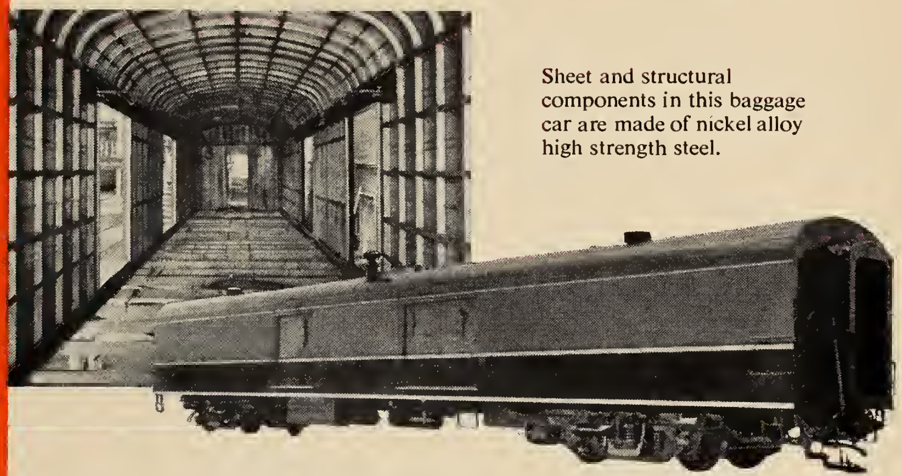
Canadian standards. Canadian Standards Association, 235 Montreal Rd., Ottawa 2.

A146-1958: Linoleum products. 75 cents.
B149-1958: Installation code for gas burning appliances and equipment. $1.00.
C13-1958: Instrument transformers. $2.50.
C22.2 No. 88-1958: Construction and test of industrial heating equipment. $1.00.
C22.2 No. 96-1958: Construction and test of power supply cable for use with approved portable apparatus, 2nd ed. $1.25.
C22.2 No. 102-1958: Construction and test of brooders and incubators. $2.00.
C22.2 No. 116-1958: Construction and test of coil-lead wires. $1.25. H.1 Series-1958: Alloy and temper designations of non-ferrous metals and alloys. 75 cents. HZ Series-1958: Zinc and zinc alloys. $1.25.

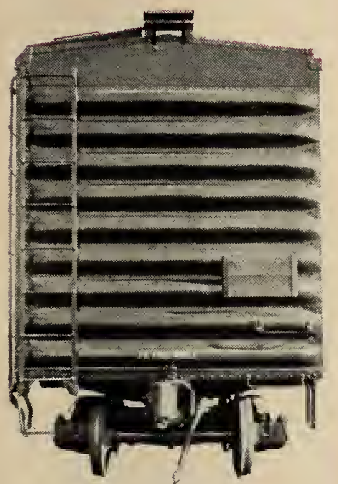
Edison Electric Institute standards. Edison Electric Institute, 750 Third Ave., New York 17, N.Y.

TD-144 1958: High voltage controllers used in street and highway lighting.

nickel-copper high strength low alloy steels reduce railroad maintenance costs!



Sheet and structural components in this baggage car are made of nickel alloy high strength steel.



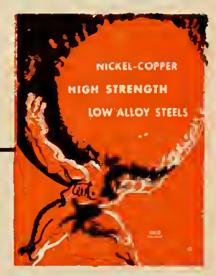
Box cars made of nickel alloy high strength steel.

Covered hopper cars produced with nickel alloy high strength steel plate.

Nickel-copper high strength low alloy steels are providing greater strength, wear and corrosion resistance for hopper cars, baggage cars, box cars and refrigerator cars on railroads. With a yield strength of 50,000 psi. minimum, the high tensile steel plate gives up to 50% longer service life than carbon steel sheets formerly used. Maintenance costs are reduced and out-of-service time cut. In many instances weight savings with the improved ratio of dead weight to payload permit more economical operation.

The same nickel alloy high strength steels that are proving themselves so successfully on railroads give similar results in a host of other applications—mine dump cars, truck hoists and bodies, tank trucks, dump trucks and car carrying trucks . . . bus bodies, barges and bridges . . . shovels, snow plows and cement mixers . . . farm equipment.

Mail the coupon below for a free copy of the booklet entitled "Nickel-Copper High Strength Low Alloy Steels", containing complete information and suggested applications.



Canadian producers of nickel alloy high strength steels:

ALGOMA STEEL CORPORATION LIMITED, Sault Ste. Marie, Ontario.
DOMINION FOUNDRIES & STEEL LIMITED, Hamilton, Ontario.
DOMINION STEEL AND COAL CORP., LIMITED, Montreal, Quebec.
THE STEEL COMPANY OF CANADA LIMITED, Hamilton, Ontario.

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EJN-2

Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

Union Carbide — F. P. Wilson, vice-president of Union Carbide Canada Limited, Toronto, has recently been elected to the board of directors of the organization. Also announced was the appointment of R. G. Leckey as manager of public relations.

Shell Oil Company — Appointment of C. A. Foster Jr. as vice-president, marketing, of Shell Oil Company of Canada Limited, has been announced. He succeeds A. L. Wilson, who has been chosen to carry out a special assignment, reporting directly to the president.

Brown Boveri — W. A. Thomann, formerly with Brown Boveri, Switzerland (a parent organization of the Canadian company), has been appointed president and director of Brown Boveri (Canada) Limited, Montreal. Further executive appointments are: C. H. Wich, executive vice-president and works manager; F. H. Fargey, M.E.I.C., vice-president in charge of sales, and secretary of the company; G. R. Labelle, treasurer and assistant-secretary.

W. A. Thomann

Canadian Broomwade — J. Dyson-Gregory has been appointed president of Canadian Broomwade Limited, Toronto. H. D. Broom, C. Broom Smith and J. Lawton Clay have been appointed directors of the company.

Peacock Brothers — B. P. Emo has been appointed manager of Peacock Brothers Limited's Toronto office. R. C. Cook succeeds Mr. Emo as Montreal branch manager.

RCA Victor Company — P. J. Casello, president of RCA Victor Company, Ltd., Canada, has been appointed executive vice-president, consumer products, Radio Corporation of America.

Phillips Wires and Cables — Due to divisional changes at Phillips Electrical Company Limited, the following appointments have been made: C. Sherman, formerly development manager, has been appointed to the new position of chief technical officer. J. E. Thomas has been named manager of the Brockville division; J. S. Waddington, M.E.I.C., becomes manager of the Montreal division. E. G. Purdy will continue as head of the Vancouver division. All three divisions will be administered from the company's head office in Brockville, Ont.

J. H. Lock & Sons — As a result of the death of R. H. Lock, the following appointments have recently taken place at J. H. Lock & Sons Ltd.: J. M. Lock has become president and general manager. C. L. Torry has been elected a director and has become vice-president; he will also continue as manager of the refrigeration and air conditioning division. H. B. Douse, secretary-treasurer, has assumed the additional position of assistant general manager. K. Davis, manager of the company's steel fabricating division.

B. P. Emo

Canadian British Aluminium Co. — The following appointments have recently been announced by the Canadian British Aluminium Company Limited, Montreal: G. Diamand, secretary and controller, succeeding the late C. W. Leslie; H. L. Murray, assistant secretary.

Canadian Aero Service — J. W. Strath has been appointed sales manager of the enlarged sales staff of Canadian Aero Service Limited, Ottawa.

York-Shipley of Canada — Announcement has been made of the appointment of R. D. Whiteman as sales manager of York-Shipley of Canada, with headquarters in Toronto.

Flintkote Company of Canada — The appointment of A. E. Field as sales manager, paving materials division of the Flintkote Company of Canada Limited, Toronto has been announced.

Brown Boggs Appointments — W. A. Dawson, M.E.I.C., has been appointed assistant sales manager of Brown Boggs Foundry and Machinery Co. Ltd. J. J. Brown, grandson of the late J. M. Brown, one of the founders of the company, has joined the sales department.

• BRIEFS

La Salle Builders Supply — Announcement has been made of the appointment of H. R. Dorion as sales manager of La Salle Builders Supply Ltd., Montreal.

National Adhesives — M. Archambault has been appointed supervisor—technical service for the Montreal division of National Adhesives (Canada) Ltd. A. Tate has been named supervisor—technical market development for the Toronto division of the firm.

Canadian Johns-Manville — Canadian Johns-Manville Co. Limited, Port Credit, Ont. has announced the appointment of J. F. Small as company representative for friction materials and industrial products.

Ensio, Whiton & Associates — R. A. Elliott, has joined Ensio, Whiton & Associates Limited, Toronto mine, mill and smelter engineers. He will deal with problems connected with consulting work in the field of mineral beneficiation.

News of Business and Industry

Disher Steel Rexdale Plant — Disher Steel Division of Dominion Structural Steel Limited, Montreal, officially opened recently their new offices and structural steel fabricating plants in Rexdale, Metropolitan Toronto. Some 300 visitors toured the spacious twin bays of the fabricating plant, each 500 ft. x 80 ft., where structural steel is fabricated by the most modern equipment. The plant layout is designed for efficient step-by-step processing of structural steel components. Four giant Taymar cranes, products of Dominion Structural Steel Limited, two of 15-ton capacity and two of 10-ton capacity, speed transfer of the steel units through the plant and to outside storage yards. On the second floor service area of the plant, visitors viewed modern production scheduling and payroll offices, and had a panoramic view of the work area below. A separate building is equipped for reinforcing rod fabrication.

Canadian Distributors — Julie Research Laboratories, Inc., New York, have announced that their products will be marketed exclusively in Canada by Philips Electronics Industries Ltd., 116 Vanderhoof Ave., Toronto, Ont. Julie Research Laboratories are manufacturers of precision laboratory equipment of very high accuracies, and precision encapsulated resistors to .01% over military temperature ranges.

New Nitrile-Silicone Rubber — A new kind of rubber was recently discovered by Canadian General Electric Company Limited, (research), combining oil resistance with the ability to maintain strength and usefulness at temperatures ranging from a sub-arctic 100 degrees below zero (F.) to the 500-plus degrees required for modern jet aircraft. Nitrile silicone rubber was described as "a major advance in chemistry that will offer industry — particularly the automotive and aircraft industries a unique combination of important properties never before available in a single material". The announcement was made by Dr. G. Suits and Dr. E. Reed. They described how basic research in chemistry performed at the General Electric Research Laboratory in Schenectady has been developed into an industrial process at the silicone plant in Waterford, N.Y. At a recent demonstration, representatives of the press saw samples of nitrile silicone rubber remain calmly impervious when immersed in hot jet fuels that caused ordinary rubber materials to writhe, curl, and swell into ugly shapes much larger than their original size.

Atlas Copco Contract — Atlas Copco Canada Ltd., Montreal, has recently announced that it has been awarded a contract to supply all the air compressors, rock drills and other pneumatic equipment which will be used in driving the Italian side of a major highway tunnel linking Italy and France through the 15,771-foot-high Mont Blanc in the Alps. This new project is regarded as one of the construction industry's greatest challenges and has been in the planning stage for years. Running approximately 7½ miles through Mont Blanc, the tunnel is scheduled for completion in 1961 at a total cost of about $16,200,000. The 29½-foot-tall horseshoe tube will have a tunnel area of 785 sq. ft. Road width will be about 23 feet. The supply contract was signed by Atlas Copco Italia S. p. A. with Societie Italiana per Condotte Dacqua, the civil engineering firm responsible for driving the Italian section of the new tunnel.

Hydro-Electric Generating Station — The Shawinigan Water and Power Company's new Beaumont hydro-electric generating station has recently been inaugurated at a ceremony at the site. The new plant, Shawinigan's seventh development on the St. Maurice river, is located approximately 10 miles north of La Tuque. When all six of Beaumont's generating units are in operation next year, the plant will have an installed capacity of 246,200 kilowatts, increasing the total capacity of the Shawinigan system to more than 1,500,000 kilowatts. The Beaumont plant was designed and built by The Shawinigan Engineering Company Limited, wholly-owned subsidiary of Shawinigan Water and Power.

Peacock Brothers Expansion — Construction of an extension to Peacock Brothers Limited's Highlands Works plant in LaSalle, Que., has recently been started. Completion is scheduled for mid-summer of 1959. This extension will actually be five times the size of the existing plant, bringing the total area to about 70,000 sq. ft., and will allow Peacock Brothers to consolidate and expand the manufacture of their Rockwell-Nordstrom lubricated plug valves in one location. These valves are now produced both at Highland and at the company's main plant, also in LaSalle. The move will, at the same time, enable the company to devote the manufacturing facilities of the main plant to the production of their other lines of engineering and industrial equipment. The new building will comprise three bays of steel frame construction. The walls will consist of masonry, continuous aluminum sash and corrugated asbestos siding. Care has been given to the general appearance and the building has been designed so that it will not clash with the adjoining residential area.

New Location — The Northern Electric Company Limited, Montreal, have recently announced the head office of the company will be located in The Northern Building, 1600 Dorchester Street West, Montreal.

Change of Address — Brunner & Lay (Canada) Ltd. have recently announced their new address at 2280 - 43rd Ave., Lachine, Que.

Public Works Contracts Awarded — Contracts involving expenditures totalling $7,253,452.56 were awarded by the Federal Department of Public Works during the month of February, 1958. The amount for new works in building construction and harbours and rivers engineering was $6,753,397.56; for the repair and maintenance of existing structures $25,055.00; and for the extension of the Mackenzie Highway $475,000.00.

Contract awards and tender calls issued during April involved a total estimated expenditure of approximately $52,075,000. Projects were being pressed forward by the Department in practically every part of the country. At St. John's, Nfld., for instance, consulting engineers engaged by the Department had undertaken surveys and the practical work of preparing contract plans and specifications for an estimated $12,000,000 harbour development to be completed over the next two or three years.

During the month of May, 1958, expenditures totalling $9,104,953.52 were awarded in contracts by the Department. The amount of new works in building construction and harbours and rivers engineering was $3,532,887.05; for repair and maintenance of existing structures $468,851.47; for the extension of highways $3,075,422.00; and for dredging $2,027,793.00.

During June, 1958, the Public Works Department awarded $12,211,291.98 in contracts. The amount for new works in building construction and harbours and rivers engineering was $10,238,097.02; for the repair and maintenance of existing structures $853,718.50; for bridge and highway construction $682,658.96; and for dredging $436,817.50.

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Technical Papers

Current Events

Professional Affairs

Employment and Business

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MEMBERSHIP

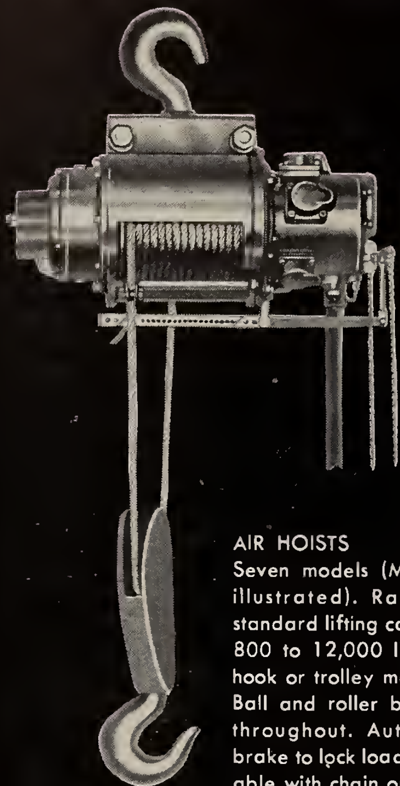
ABC CCAB BNA

Indexed in The Engineering Index

(19,950 copies of this issue printed)

Air Tools proved most efficient and economical in FORD Study

In a Study of High Frequency Electric Versus Air Tools by the American Ford Motor Company, air tools proved to be "...most efficient and economical on an overall basis..." Actual use demonstrated that there is practically no limit to the adaptability of air tools. Averaging 50% lighter and being much cooler in operation than similar electrical tools, they increased operator efficiency. The Ford Study also revealed that an average ratio of 7 out of 10 operators questioned *preferred* to use air tools.



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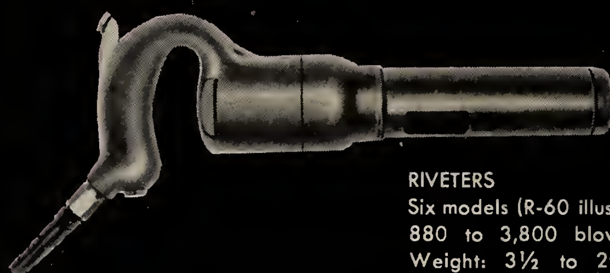
STRAIGHT GRINDERS
Fifteen models (LSR-11 illustrated). Range: 2,600 to 65,000 r.p.m. Weight: 1¼ to 16¾ lbs. Designed for use with all types of wheels, mounted points and rotary files. Frictionless governor positively prevents overspeeding.



RIVETERS
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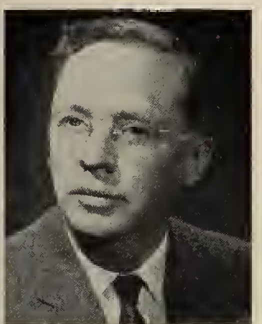
CS-113 B&W

MEET THE AUTHORS

Hugh G. Conn, M.E.I.C., Dean, faculty of applied science, and Head, department of mechanical engineering, Queen's Uni-



versity, Kingston, Ont. *(Engineering Education in Canada).*

With a background of service in industry and the army, H. G. Conn was educated at Queen's University from which he graduated with a B.Sc. degree in mechanical engineering in 1931.

In 1932 he joined the firm of Procter and Gamble Company Limited, at Hamilton, returning to Queen's University as a lecturer in the mechanical engineering department in 1937.

Dean Conn served with the Royal Canadian Electrical and Mechanical Engineers from 1939 until the end of the war, returning to Canada in 1945.

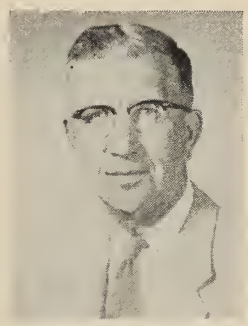
He completed work for an M.S. degree at the University of Michigan in 1946. That fall he was appointed head of the department of mechanical engineering at Queen's; he became dean of the faculty of applied science in 1955.

He was elected vice-president of Zone B of the Engineering Institute, representing the Province of Ontario in 1958, following service as a councillor, Kingston Branch, E.I.C., 1955.

He is chairman of the Canadition Advisory Committee of the Institution of Mechanical Engineers (London).

H. C. Gunning, M.E.I.C., Consulting Geologist, Anglo-American Corporation of South Africa, Salisbury, Rhodesia. *(Trends in Engineering Education).*

Dean Gunning graduated from the University of British Columbia in 1923 with a B.A.Sc. degree in geological



engineering. Later, he attended the Massachussettes Institute of Technology, obtaining a S.M. degree in 1926, and a Ph.D. in mining geology in 1929.

He was associated with Geological Survey of Canada as geologist from 1928 to 1939. That same year he joined the staff of the University of British Columbia as professor, department of geology and geography. Named department head in 1949, he was appointed dean of the faculty of applied science in 1953.

Apart from his contribution to the field of education, he has been active as a consulting geologist for various mining companies. Among them are the International Pacific Sockeye Salmon Commission, and Mannix Co. Ltd.

He is a Fellow of the Geological Society of America and of the Royal Society of Canada. He was a member of the National Committee on the Removal of Ripple Rock, and the National Advisory Committee on Research of Geological Sciences.

R. E. Chamberlain, M.E.I.C., Project Engineer, Dominion Bridge Company Limited, Montreal. *(Modification of the Jacques Cartier Bridge for the St. Lawrence Seaway).*

Educated in Montreal, he graduated from McGill University in 1951 with a B.Eng. degree. After further studies at the University of Birmingham, England, he obtained a Ph.D. in 1953. On returning to Canada, he joined the staff of Dominion Bridge Company. He had

worked for the organization as a student, during summer months. In 1954-1955 he was engaged on the Jacques Cartier Bridge project under the direction of the late Dr. P. L. Pratley, Montreal consulting engineer.

Since 1956 he has been at work on the project for Dominion Bridge.

COVER PICTURE

Practical training is one of the most important elements in preparing technical specialists in Canada. The importance of higher education in a young and progressive country such as ours cannot be overrated and it is through such education that great strides will be made toward scientific, technical and cultural progress for the benefit of all Canadians.

Our cover picture shows students at work in the Chemistry Laboratory at the University of Toronto.

Photo: Eric Trussler

FRANKI FACTS

How Franki Caissons quickly overcame unexpected, troublesome silt layers

Client :
200 Queens Ave. Ltd.
Location :
London, Ontario
Architects :
Watt & Tillmon
London, Ont.
Cons. Engineers :
M. M. Dillon & Co. Ltd.
London, Ont.
Type of Structure :
Office Building
General Contractor :
Pigott Construction Co. Ltd.
Hamilton, Ontario
Number of Caissons :
180
Working Loads :
90 tons

TYPICAL BORING LOG

The Problem

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A tight construction schedule was endangered.

The Solution

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The Results

Within one week of this decision, two modern, hydraulically operated Franki caisson-driving rigs were on the site and erected — even before excavation was completed.

Within less than 4 weeks of the decision to use Franki, and after only 12 driving days, the caisson work was completed.

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Literature-This series of job highlights, as well as other descriptive literature, will be sent to you upon request to Franki of Canada Ltd., 187 Graham Blvd., Montreal 16, P.Q.

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FOREWORD

ENGINEERING EDUCATION

WE ARE NOW WITNESSING in Canada a period of rapid growth in the field of engineering education, and particularly a growth in the number of engineering colleges which teach engineering. I am pleased to see these new colleges begin this work. It is only the arrival of these schools which will arrest the growth of the older teaching institutions, some of which are admittedly already too large for the good of their students.

One wonders whether engineering students in Canada receive the real benefits of a university education. In a recent visit to the U.S.S.R., when I had an opportunity to take a quick look at their engineering schools, the thing that struck me first was the fact that their institutes of engineering are separate autonomous colleges, operating under the Ministry of Higher Education and are not physically located near nor academically attached to the universities.

It seems to me that Canadian universities will have to make a very deliberate effort if they are to prevent their faculties of engineering operating in such a fashion that the engineering student will derive no benefit from the other faculties on the campus.

The hazard is a multiple one. Curricula can come too completely under the control of the enthusiastic engineering teachers. The students can sit in classes only with other engineering students. Unless dormitory accommodation on a university wide basis is provided the engineering student can live only with other engineering students and miss one of the most enriching experiences of a lifetime.

It is difficult to change customs which have become firmly established. Newer institutions should be vigilant in watching over and shaping the pattern of their growth. In this way they stand a good chance of producing not just embryo engineers but university graduates with an engineering education.

It has always alarmed me a bit that young men seeking a university education should be so sensitive to job opportunities of the moment, and so unaware of the possibility of getting an education which will last them the whole of their working lives. The comparatively rapid swing of enrollment from one course to another and the quick rise and fall in engineering enrollment with economic changes are evidence of this.

This is something which all engineering counsellors can keep in mind. Whether anything can also be done about it in the offices of university registrars and directors of admissions one does not know. There is a limit to which responsible adults can go in trying to guide young people.

PRESIDENT
The Engineering Institute of Canada

ENGINEERING EDUCATION IN CANADA

H. G. Conn, M.E.I.C.

MOST professional schools in Canada, including the engineering schools, have developed as a Faculty affiliated with a well-established Liberal Arts College or university, whose prime function is to "educate" or to create an atmosphere where true learning is made somewhat less difficult. Thus it is natural, that as the professional schools began to grow, they set themselves high standards of education, as well as of training. This was undoubtedly influenced by the fact that in any engineering course a considerable part of the teaching in the early years is by professors in the sciences, familiar with high quality research and with the teaching of basic fundamentals. Since the engineer must first be a useful citizen, it is essential that he have as liberal an education as possible, consistent with the technical requirements of his profession.

How do we attempt to do this?

It is fortunate that in Canada we have a fairly uniform primary and secondary school education system, administered by the provincial governments. Each university requires that a candidate pass the provincial examinations in mathematics, physics, chemistry, a language, and an option, with some minimum standing, the minimum varying with each university. Some universities, which receive their major financial support from provincial funds, are obliged to accept all candidates who meet their minimum requirements, while other schools supported by private funds may restrict enrolment at their own discretion.

In Canada there is a continual turmoil over the apparently ever-changing quality of the students coming to university. There are those who are convinced beyond any shadow of a doubt, that the oncoming generation is the poorest trained lot to date and that they are getting worse. When one realizes that more and more is being crammed into curricula, and more and more is expected of the student, and in spite of this the failure rate is not increasing, it is difficult to justify the statement that the students are not as well prepared for university life today as they were many years ago.

This defence of the high school graduate must not be a substitute for a determined effort to choose more wisely those to be admitted. If restricted enrolment is inevitable, the restriction should be because of a lack of people who will benefit from a university education, rather than due to a lack of space or facilities. All schools are seriously concerned with the problem of the selection of the proper candidates.

Let us assume that a boy has set his heart on engineering, has done well on the required high school examinations and has been fortunate enough to be selected as a candidate at a university. One of his first problems will be that of financing. If the boy will be livng away from home, and by far the majority do live away from home, he must figure on $1200-$1500 per year to cover fees, board and room, and general expenses. During the three summers he can save a clear $300-$700 per summer or even more, depending on the particular job and its location, with respect to sources of spending. Some boys who spend their summers in remote places do very well financially.

Most engineering schools have a very liberal scholarship program for the top students. Other students may be helped by bursuries. There are, however, many students who are not brilliant enough to win scholarships and whose parents are not poor enough to entitle them to bursuries, who must fend for themselves. Some loan funds are available for students who find themselves embarassed by an unforeseen need for funds. The loans normally allowed are not large and preference is given to students in the upper years, who have established some confidence that they will graduate.

The school term in Canada is fairly uniform at approximately seven and one half months at school and four and one half months at work. The cooperative program has just recently been started in one of our schools, but it is too early to comment on it.

As one studies the various curricula across Canada a pattern quickly appears. The first year, although not always common to all branches is weighted heavily with mathematics, physics and chemistry. In addition some professional subjects are included, such as surveying, drawing, etc. Almost all schools attempt in various ways to include as much of the humanities as time will permit. Much of the academic work in the first year is a continuation of the work of the high school, but the student is introduced to the wonders, newness and challenge of calculus, dances, freedom of study habits, football, new concepts in physics and chemistry, a rather rigourous social life, and last, and far from least, the panic, despair, and elation associated with writing examinations and watching for the results.

Table I. Distribution of Engineering Graduates in Canada 1947 - 1956*

Year	*Chem.*	*Civil*	*Elect.*	*Mech.*	*Mining*	*Metall.*	*Geol.*	*Eng. Phys.*	*Other*	*Total*
1947	176	261	272	255	54	35	23	62	37	1,175
1948	208	388	396	365	109	49	49	98	74	1,736
1949	401	664	734	723	170	82	117	166	252	3,309
1950	466	769	881	794	157	92	86	133	213	3,591
1951	321	573	522	572	97	73	75	81	136	2,450
1952	212	529	339	336	60	47	47	62	85	1,717
1953	177	440	233	316	42	24	34	46	44	1,356
1954	163	350	228	296	38	30	38	45	57	1,245
1955	170	391	240	331	43	30	47	63	77	1,392
1956	242	443	345	360	40	48	59	68	80	1,675
1957	219	508	409	375	57	59	43	90	97	1,853

**The Engineering Journal* (Revised 31 Dec., 1957).

When examinations are through and all the sums have been made, a very consistent 20% to 25% of the first year have dropped by the wayside. Some of these will return and finally graduate, while others will find use for their talents in other fields.

The second year is a particularly dangerous year. The 75% who have passed their year are now confident that they have the ability to succeed, some without too much effort, and settle back to obtain a well-rounded "education" of which their academic work assumes too small a portion. Their degree is still three years in the future, some of their enthusiasm has waned and temptations are many. The work in the second year is heavy and the professors grind on relentlessly. The result is that another 20% to 25% drop by the wayside, as a result of what is called the "sophomore complex" or the "second year slump". The work of this year is also concentrated on fundamentals, mathematics, physics, chemistry, and some more of the humanities.

In the third and fourth years the students come to grips with their professional courses, their interest rises, the poorer students have been eliminated, and convocation day is now on the horizon. The result is a raising of spirits and a lowering of failure rates.

In preparing the work to be covered in a four year engineering course, some schools lean toward the scientifically oriented curriculum, intent on producing only high quality scientific engineers, leaving to others to deal with what has been established as a "traditional" engineer, a good balance of "know how" and "know why".

Other schools set their sights to help the good solid practicing type of engineer, knowing that a world full of thinkers only would result in a dull and unprogressive state of affairs.

But most schools steer a wobbly path between these two, veering one way and then the other, depending upon economic conditions, the influence of industry, the alumni, and the personnel of a teaching staff. The oscillations of expressed objectives seem to be timed to the frequency at which Sputniks are sent careening into space.

In the minds of some there is a lack of appreciation of the fact that to be a good doer you must also be a good thinker, and that there is not a fine line separating these two species.

The difference between the products of these two schools is frequently much more imaginary than real, the difference existing more in the minds and ambitions of the respective staffs, than in fact.

There is, however, a general drift toward the scientifically oriented curriculum.

I suppose it is as true in other countries as it is in Canada, that in a few years a large wave of people of university age will be upon us. Even with no increase in the percentage seeking admission to universities, and with no increase in the percentage of these who will be wishing to study engineering, facilities and staff will be inadequate to meet the problem. Most engineering schools in Canada have plans for the doubling of space by 1965. We have heard much about the spending of many millions of dollars on buildings and equipment but have heard very little about the spending of even small portions of this amount *now* for the provision of the necessary staff. There are very few serious space problems that a few million dollars cannot solve. Buildings can be built and equipped well within a two year period. The solution of staff problems is not so easy. It is not sufficient to "buy" a technically competent engineer from industry. He must first have a desire to teach and not merely to circulate in an academic atmosphere associating with and showing an interest in, only those who are equally qualified. He must have a longing to discover new things through research and to talk about his work with the students. If he lives his subject the students cannot help but learn since there is nothing more contagious than enthusiasm.

Buildings and equipment are usually at their best the first day they are used. Not so with staff. A certain aging process is required before a teacher is effective. If the staff of 1965 is to be a mature one, the aging process must start now.

Not only are buildings and equipment over-crowded, but curricula are also feeling the effect of having more

Table I(a). University Enrolment and University Graduates, 1946 - 1965.

Year	*Total University Enrolment*	*Engineering Graduates*
Actual		
1946	61,861	1,006
1947	76,237	1,096
1948	79,346	1,690
1949	75,807	2,999
1950	69,111	3,598
1951	64,036	2,427
1952	59,849	1,770
1953	60,046	1,337
1954	61,178	1,252
1955	64,300	1,337
1956	68,300	1,709
Predicted		
1957	74,600	1,853
1958	78,700	2,050
1959	83,600	2,240
1960	89,000	2,420
1961	95,100	2,600
1962	101,900	2,810
1963	109,400	2,040
1964	118,000	2,300
1965	126,500	3,580

Source: Federal Department of Labour. (Revised 31 Dec., 1957.)

TABLE II. Net Immigration of Engineers to Canada, 1951 - 1965

Actual	*Immigration*	*Emigration*	*Net Immigration*
1951	970	447	523
1952	1,466	538	928
1953	1,900	529	1,371
1954	1,687	494	1,193
1955	1,315	615	700
	Estimated Annual Averages		
1956 - 1960	1,570	630	940
1961 - 1965	1,360	680	680

Source: Federal Department of Labour.

Table III. Total Supply of New Engineers in Canada, 1951 - 1965

Actual	*Graduation*	*Net Immigration (Table II)*	*Total*
1951	2,427	523	2,950
1952	1,770	928	2,698
1953	1,337	1,371	2,708
1954	1,252	1,193	2,445
1955	1,337	700	2,037
	Estimated Annual Averages		
1956 - 60	2,040	940	2,980
1961 - 65	3,060	680	3,740

Source: Federal Department of Labour.

and more added. The reasons for a crowded curriculum are obvious. With tremendous strides in scientific development and the associated responsibility that new discoveries be used for and not against mankind, it is natural that more and more must be placed before the student. The only difficulty in adding some new topic to a curriculum comes when you must say what shall be eliminated. Most schools now work on a thirty to thirty-five contact hour per week basis. If you add twenty-five to thirty study hours per week to this the week is as full of formal education as is wise.

One answer to the crowded curriculum is a five year program. There is some feeling in Canada that the five year program must come, but as yet the feeling has not gathered enough momentum to make a move in this direction a practical one. When such a move is made it must be made by all schools and the objective must be clearly stated, either to allow for the introduction of more material into the course or to cling to the teaching of the existing fundamentals but use the additional time to study these fundamentals more thoroughly. The success of a scientific engineer after graduation is more closely related to the thoroughness of his understanding of the basic fundamentals than his knowledge of facts. The practicing engineer must also have available many facts as well as being able to apply the fundamentals. However, the facts can be gathered more effectively after graduation on the job where they have more meaning and where there is some justification for trying to remember them.

And now a word about the role that research plays in Engineering Education in Canada. It is a generally accepted fact that salaries in industry exceed those at a university. While the difference was rather pronounced in the past, there has been a gradual improvement in the situation. One must look at the overall picture to discover the compensations that make it possible to attract and to hold able staff. One of the significant features of work at a university is the freedom to seek a path of one's own choosing and to follow it, or any of the side-roads that may develop, with no justification required, other than that something new is learned and that constructive thought is stimulated. Thus it is only natural that many engineering professors become engaged in what is called research or development. This is no place to argue about the differences between fundamental research, research, development, or technical investigations. In this context I am speaking of the whole field of thought and endeavor above and beyond the details of day-to-day teaching.

While universities have made and will continue to make an important contribution as a result of their research, they cannot hope to compete with government bodies, or the research divisions of industry, insofar as quantity of research is concerned. With limited funds and facilities what is the justification of research work being done in an engineering school?

Table IV. Estimated Number of Engineers in Canada, 1953 (including 1953 graduates)

Aeronautical	400
Agricultural	260
Chemical	3,200
Civil	8,500
Electrical	6,900
Engineering Physics (including physics)	2,400
Forest Engineering (including forestry)	1,950
Geological Engineering (including geology)	1,400
Mechanical	7,200
Metallurgical	1,100
Mining	2,800
Total	36,110

Note:—This is quite near the *best estimate* of this figure give by the Bureau of Technical Personnel as 35,738.

Source: Federal Department of Labour, Economics and Research Branch.

Most of my colleagues will agree that without this research work the staff and the work they do become stagnant and uninspiring, teaching becomes a mechanical process, creativity dies, first class students become numb, and talents are misused.

Even though the students do not take an active part in research work, they do, however, rub shoulders with the graduates and staff, who become involved with and have an enthusiastic interest in some particular investigation. Such work in a department opens doors to the more inquisitive, and attracts to further study students who would otherwise follow the path of the crowd.

I think that a critical examination of the Canadian engineering picture would reveal that there is far too little real research being carried out at the universities. This is gradually being corrected as young recent graduates find their way to positions on the staffs of engineering departments and bring with them their new Masters or Doctors degrees, and particularly their new ideas and the result of recent learning at other institutions.

The position of Junior Colleges or "feeder" schools has been an important one in Canada. These are schools who are in a position to give the maths, physics and chemistry, and some other subjects equivalent to the first year or two at a university, but who do not have the facilities for the professional work in the upper years. Each such school usually patterns its course after the first year or two of a particular university, so that their students may enter the upper years with as little difficulty as possible. With much overcrowding in

(Continued on page 43)

Table V. Estimated Number of Engineers in Canada, 1957

Estimated Total in 1953			36,110	(Table IV.)
Plus graduation in	1954	1,252		
	1955	1,337		
	1956	1,709		
	1957	1,853	6,151	(Table I.)
Plus net immigration	1954	1,193		
	1955	700		
	1956	940*		
	1957	940*	3,773	(Table II.)
Total			46,034	
Less Normal loss by death, retirement, leaving profession, etc.*			2,600	
Net Total Engineers, 1957			43,434	

*Estimated.

Source: Federal Department of Labour.

Table VI. Engineers and Professional Workers on the Canadian Labour Force

Year	*Labour Force*	*Professional Labour Force*	*Engineers*
1931	4,151,000	201,000	15,518
1941	4,466,000	240,000	20,501
1951	5,132,000	303,000	31,461
1956	5,600,000	357,000	40,000
1957	5,636,000		43,434

Source: Federal Department of Labour.

TRENDS IN ENGINEERING EDUCATION

H. C. Gunning, M.E.I.C.

BEFORE discussing general trends in engineering education and the relation of these to the business activities of engineers, it will be wise to recall some of the fundamental factors that influence the design of any engineering curriculum. These influences exist because we are dealing with the education of professionals who, in common with members of other learned professions, have legal rights and responsibilities that have been granted to them by the public through their elected parliamentary representatives. In Canada these rights and responsibilities are set forth in provincial "Acts Respecting the Practice of Professional Engineering" and the regulations or by-laws that accompany those acts. The acts and by-laws are administered by provincial Associations of Professional Engineers. Much of the detail of administration is performed by the councils of the associations which consist entirely of professional engineers who served voluntarily and without remuneration.

Accreditation of Engineers and Engineering Curricula

Possession of a university degree in engineering or applied science does not confer upon the holder the right to practise as a professional engineer. The power to confer that right rests in the hands of the Association. The British Columbia Act stipulates that an applicant for membership in the Association must submit satisfactory evidence that "he has graduated in applied science or engineering from an institute of learning approved by the Council *in a course approved by the Council*". Courses prescribed by a university faculty are not automatically accredited by Council. Council also has the right to demand evidence of satisfactory engineering experience and of good character and repute. In British Columbia at present the period of experience after graduation is a minimum of two years. A satisfactory "thesis" or engineering report is an additional requirement for registration. The activities of the provincial associations are coordinated by a Dominion Council on which each association has one representative.

Professional Responsibilities

The concept of a profession has been established in the public mind largely by the professions of theology, law, and medicine. These were the fields of professional study in the universities after their establishment in Western Europe early in the 12th and 13th centuries. By their competence, integrity, and service to mankind these professions won prerogatives that are the basis of all true professions as we know them today. A great American educator and scientist has phrased it as follows: "There has been no true profession that has not with dignity and authority advised and counselled the people, that has not guarded the Commonweal. For a true profession exists only as the people allow it to maintain its prerogatives by reason of confidence in its integrity and belief in its general beneficence".

Competence, integrity, and public service—these are the cornerstones of professional ethics. Public service includes protection of the public, and in particular, protection of the public in professional activities. All three attributes should be instilled in the student by any professional curriculum. But without the first, competence, no person can fulfil his professional obligations. Consequently, professional competence must be a primary goal of all professional curricula. "The most ardent advocate of a wider education would be displeased if our bridges collapsed, our electric light failed, our drinking water became polluted or our oysters became radio-active."[1]

Modern Trends in Engineering Education

The general trend in engineering education today is toward more emphasis on skill in the basic sciences —mathematics, physics and chemistry; less specialization in engineering techniques, especially those that can be acquired during professional experience; and increasing breadth of training in English, history, economics, and human relations in general. The objective is to provide a broad training in engineering and the related sciences, an acceptable minimum of specialization in any particular branch of engineering and a maximum of acquaintance with the resources of the humanities and the social sciences. It is thought that the last will benefit the student as a professional, as a citizen, and as an individual.

The attainment of these ideals is not easy, but much progress has been made in the past ten years or so. I hardly need to mention to this audience the additional demands on the curriculum that have been made by spectacular recent advances in the basic sciences of engineering. We are faced with the necessity of greatly increased instruction in nuclear physics, at the junior and senior level, and with the necessity of supplying recruits for nuclear engineering from almost all branches of engineering. Several schools have felt it necessary to establish departments of nuclear engineering at the undergraduate and post-graduate level. Organic chemistry has not been, in the past, a part of the training of engineers except those in chemical engineering. The rapid growth of industries based on synthetics has made it apparent that organic chemistry should be included in the training of other engineers who have to work in these industries or use the new materials. The application of analogue and digital computors and the expanding application of electronics and servomechanisms mean that greater facility in higher mathematics is a necessity for many engineers. The tremendous importance of geophysics in the development and exploitation of our mineral resources and in other engineering operations means either that engineering physicists and electrical engineers should have a better training in earth science or geologists and mining engineers should have more

1 R. P. Linstead; "The Future of Imperial College"; 1955.

physics and mathematics. Physical metallurgy has become in recent years almost a new discipline demanding greatly increased knowledge of metal physics and metal chemistry, of X-rays, radio-activity, and other things. A host of complex, intricate machines have, almost overnight, graduated from the research laboratories to become the ordinary tools of the engineer. The engineering curricula are being adjusted every year to include a wider range of science as well as more advanced training in several sciences. At the same time there are pressing needs for other adjustments and improvements. Many of the old requirements remain. The slide rule and the draughting board are still with us.

Administrative Obligations in Industry

I have read the suggestion, made in all seriousness, that engineers should be used only in design and research. Operations should be left to the technicians—of whom in Canada we have too few and for the training of whom our facilities are woefully inadequate. Management should be left to the non-technologist. A recent reply to this attitude is: "With a technology whose complexity is increasing at a geometrical rate, amateur judgments and cut-and-try methods, however well-intentioned, simply will not do. The skills and training of the engineer are needed just as much in the direction (management) of industry as they are in technical operations." Another article, in advocating the necessity of technologists in management and the need for considering this in their academic training, lists a few of the highly competent technologists who have been responsible for much of the spectacular industrial growth on this continent: Westinghouse and Swope in the electrical industry; Sloan and Chrysler in the automobile industry; Thomson, Dodge and Budd in the railroads. We could add many Canadians in these and other industries. Figures I have seen indicate that about 60 per cent of engineers are seriously involved in industrial or professional management fifteen years after they graduate. Therefore our basic assumption is that the curriculum must include as much as possible of the general education that is helpful and important in management. It is also assumed that if the young engineer cannot, for the first few years, make a success of the practice of his own profession, he is not likely to assume a supervisory or managerial position in technologic operations. It is to be hoped that management will see that the abilities or skills of competent engineers will not be wasted unnecessarily in the management of non-technical operations.

General Education of Engineers

The attempts to satisfy the need for general education in the engineering curriculum vary with each academic institution. I would be surprised if you found in any institution unanimity of opinion either in the engineering faculty or in the faculty of arts and science. Many institutions, including The University of British Columbia, have doubled or tripled the time devoted to general education within the past ten or fifteen years. I should say at the start that none of the programmes I have heard of include specific training for business or management as such, except in the case of a few special "hybrid" courses such as "Engineering and Business". It should also be clearly understood at this point that the dollar or the pound sterling is one of the basic factors of all engineering training; that all engineers (well, nearly all) are given courses in things like industrial engineering or engineering economics and that it is thought they are trained to be cost-conscious. It is said that the obligation of an engineer is to do things better at less cost. If this were not so, with our wage structure for labour progressing upward as it has, I suspect that there would be no profit from which to pay wages, and we should be in a very unhappy position. This kind of training is part of the orthodox curriculum and I am considering now only the new needs and the new trends.

I will consider two major approaches to the broadening of general education: one is voluntary, the other compulsory.

The first may be represented by the recent trend at Imperial College in London. It has been discussed in the inaugural address "The Future of Imperial College" by the new Rector, Dr. R. P. Linstead, and he has generously supplied me with some additional detailed information, as follows:

"Since 1952 the College hours have been adjusted on Tuesdays and Thursdays throughout the Autumn and Spring terms. This enables us to have a break of two hours at lunch-time. General Studies take place from 1:30 to 2:30 p.m. On any one day there is a choice of two or three talks. The speakers are visitors distinguished in a very wide variety of fields. The talks are informal, and it is left to the speaker to allot as much time as he likes to discussion. Attendance at the talks is voluntary, and no register is kept; the numbers attending vary a good deal, from a maximum of about 200 to a minimum of about 40 for any one talk. The speakers are unpaid, only their out-of-pocket expenses being met by the College.

"Week-end discussion groups meet twice a term. They were started in 1950 by my predecessor, who gave them the name of 'Touchstone Week-Ends'. They are held at the College Field Station at Sunninghill, Berks, some twenty miles from London. A topic is chosen for discussion, and a distinguished speaker is invited to introduce it. About thirty staff and students travel to Silwood Park on the Saturday afternoon, and are joined at Silwood by some of the staff and students who work there. After tea the guest speaker introduces his subject, and this is followed by a general discussion. After dinner the party usually splits into two or three groups to discuss questions subsidiary to the main topic. Sunday morning is free; the party reassembles after lunch, the spokesmen of the groups report their findings and the guest speaker sums up the discussion. The party returns to London in the early evening. Some recent topics were: 'The Changing Concepts of Psychological Medicine', introduced by Dr. E. B. Strauss, Physician for Psychological Medicine, St. Bartholomew's Hospital; 'Telepathy', introduced by Dr. S. G. Soal, Senior Lecturer in Mathematics at Queen Mary College; 'The Artist and the Material World', introduced by Mr. Basil Taylor, Librarian of the Royal College of Art, and well-known critic and broadcaster.

"Some titles of The General Studies addresses at the noon meetings are as follows: 'World Unity and World History', Professor Arnold Toynbee; 'Walking in the Alps' (with slides), Hubert Walker; 'The Enjoyment of Music', Antony Hopkins; 'Sources of the Russian Revolution', Professor G. H. N. Seton-Watson; 'The Impact of the Oil Industry on the Persian Gulf Shiekhdoms', Sir Rupert Hay; 'The Americans—How did they get that way', Professor Arthur Newell; 'Philosophy: (II) Existentialism—A Modern Revolt Against Science', H. J. Blackham; 'Anthropology and Problems of Industrial Organization in Western Societies (I)', J. A. Barnes."

The other approach may be illustrated by efforts that are being made in many American schools with pressure and a great deal of good work by The American Society for Engineering Education.[2] It should be noted that the minimum length of the engineering course in the United States is four years after the equivalent of a good Canadian junior matriculation whereas in Canada it is four years after senior matriculation. On the other hand, each year in the United States' colleges is a little longer than ours. Canadian students, almost without exception, gain very valuable technical experience for four months each summer.

The general A.S.E.E. programme calls for a minimum of 20 per cent of the engineering curriculum being devoted to general studies, distributed if possible more or less evenly throughout the four years. There is difference of opinion as to whether the general courses should be specially tailored for engineers or whether they should be regular courses offered by the liberal arts faculty. On the whole, the former seems to be favoured in most good schools. One of the most emphatic recommendations is that *humanistic-social studies must be distinguished from business training* and that the latter must not count as part of the general programme. The titles of some of the "tailored" courses will give you some idea of the content: History of Western Civilization; Foundations of Western Civilization; The Background of Western Civilization I, II, III, IV; Introduction to the Humanities; Economic Analysis and Contemporary Problems I and II; and Public Affairs. History, Economics, and English occupy the prominent roles but Philosophy and Psychology are admissible. It is claimed that some thirty reputable schools have proven that this kind of training can be included in the curriculum without endangering the professional competence of the students. Several have attained the 20 per cent ratio. Stanford, California Institute of Technology, Michigan State, Massachusetts Institute of Technology, North Carolina State, Case Institute, and Clarkson College are among the prominent examples.

Most Canadian universities keep in close touch with American trends and benefit by them and by the British developments. At present I judge that we, as is the case in other things, have adopted a course intermediate between the two extremes. At The University of British Columbia, nearly all engineers now take every year at least one course that qualifies as general studies in the American pattern. There is also a good deal of the voluntary approach, for which the students get no official academic credit.

I would not leave the issue without affirming that many engineering educators believe that administrative ability and business acumen are among the human qualities that can be classed as "gifts"; that for those who have the gift much can be gained by practical experience, personal and post-graduate study; and that the approach that is developed by good training in the solution of scientific and particularly of engineering problems should be very helpful to the young man who may later find himself drafted into business and administration. Many professional engineers take post-graduate courses or degrees in Commerce or Business Administration and it is important that first-class training of this kind should be available.

2 "General Education in Engineering"; The American Society for Engineering Education, 1956.

Engineering Education . . .

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the early years the universities have been anxious to make arrangements with well-established Junior Colleges to admit students direct to the second or third year. This enabled them to offset to some extent the drop in class numbers due to normal wastage.

However, the picture is changing. As the demand by industry for engineers became more pressing and as hopes for money for the training of larger numbers of engineers became more promising, these schools developed their facilities to the point where many of them are now offering courses leading to the engineering degree. Such schools as Carleton University, McMaster University, University of Western Ontario, University of Ottawa, University of Sherbrooke, and Essex College, are at various stages of offering the degree in some branches of engineering. Those responsible for such details as finding staff have a particularly difficult piece of work ahead of them and the established schools must look forward to contributing staff if the work of the next schools is to be integrated properly with the balance of our Engineering Education system. No one likes to lose a valued staff member, but there is some consolation in having had one of your colleagues chosen to take part in the development of such an important undertaking.

Some question the wisdom of establishing new facilities at the present time, although few will argue against expanding exisiting facilities. It would be unfortunate if available teachers and money were spread unnecessarily thin in an attempt to meet a demand from industry for more engineers, unless, of course, the demand is a real one. Although no one will question that there is and always will be a need for good quality creative engineers, there is some cause to doubt that there will continue to be a need for engineers to be employed on other than engineering work, work that could be done equally well by competent technicians, *if they were available in much larger numbers than at present.* While thinking along these lines it must be recognized that many employers prefer to engage engineers on work which is not strictly engineering, but which requires an engineering or analytical approach.

Earlier I referred to there being approximately four and one-half months each summer, during which the students can earn a considerable sum of money with which to finance the next year. Most students are required to spend their summers at some work associated with their profession, in order that their school work will have more meaning, and so that they may more intelligently choose a field in which to work after graduation. It is more important that the student work in an engineering atmosphere, even though his task may be that of a labourer, than to have what appears to be a highly skilled job, but without the opportunity to look around to see what other people are doing and to talk with engineers and others about their problems.

Knowing that statistics are frequently misleading and present only a quantitative picture of the problem, I have refrained from quoting figures in this talk. There is, however, an appendix available, setting out certain data which may be compared with similar data gathered from other sources.

an artist's impression—before and after modification.

MODIFICATIONS TO THE JACQUES CARTIER BRIDGE

Ross E. Chamberlain, M.E.I.C.

THE Jacques Cartier bridge, which links the Island of Montreal with the south shore of the St. Lawrence River, consists of three main sections. The north approach passes over part of the City of Montreal and is about 1,950 ft. long. The 1,937 ft. main cantilever structure is a familiar landmark to most Canadians. It crosses the Montreal Harbour with a clearance of 155 ft. The third section of the bridge is the 4,930 ft. south approach which passes over St. Helen's Island and crosses the portion of the St. Lawrence River between that island and the south shore. Fig. 1.)

When the bridge was built, about thirty years ago, most proposals for a St. Lawrence Seaway envisioned a channel on the north side of St. Helen's Island. If this were the case, the main cantilever span would have provided ample ship clearance. The congested Montreal Harbour on the north side of St. Helen's Island, and other factors, forced the final Seaway planners to locate the channel close to the south shore. Consequently, it became necessary to alter the portion of the Jacques Cartier bridge which lies south of St. Helen's Island.

This section of the bridge consists of a series of simple deck truss spans. The trusses are 40 ft. apart and support floorbeams which rest on, and cantilever over, the top chords every 24 ft. 6 in. The concrete deck is supported on longitudinal stringers. The original roadway was 37 ft. wide and placed centrally on the bridge. On each side of the roadway was a lane to be used for tramway lines and then a 5 ft. sidewalk. In 1955 a concrete deck was placed on the downstream tramway lane making the overall width of roadway 48 ft.

The first three spans from the south shore are 122 ft. 6 in. long with trusses 13 ft. deep. Spans, 4, 5, 6 and 7 are 147 ft. long and the trusses are 25 ft. deep. All spans are completely independent except that at pier 3, span 3 rests on a post from the first bottom chord panel point of span 4, thus at this pier there is only one floorbeam and one pair of pier members.

Spans 8 and 9 are 196 ft. long with trusses 30 ft. deep, while the spans north of pier 9 are 245 ft. long and are supported by 35 ft. deep trusses. The depth changes at piers 7 and 9 are allowed for by 5 ft. high concrete pedestals on the pier tops which support the pier members of the shallower spans. The total dead weight of one span varies from 680 tons for a 122 ft. 6 in. span to 1330 tons for the 245 ft. spans; 56% of this weight was on the downstream side due to the unbalanced roadway deck. The total dead weight of

The Jacques Cartier Bridge, which crosses the St. Lawrence River at Montreal, had to be modified to give the 120 ft. vertical clearance required for the St. Lawrence Seaway. This necessitated an increase of 83 ft. in the original clearance, with a minimum of interference to the bridge traffic, and absolute safety to the public who traverse this bridge to the extent of some 35,000 vehicles per day. This paper describes the two methods used to attain these results. The roadway profile was changed by physically jacking the bridge spans and building up the piers by varying amounts to increase the clearance by 50 ft. The remaining 33 ft. was gained by replacing one of the original deck truss spans with a new through truss span.

bridge lifted totalled some 14,000 tons.

From south to north the original roadway profile was up at 3.08% until pier 7 where the grade flattened to 1.01%, which was then constant to St. Helen's Island.

As it was desirable to keep the Seaway channel close to the south shore, it was designed to pass under span 10, the first 245 ft. span. This would provide the required lateral clearance for the Seaway channel.

The St. Lawrence Seaway clearance requirement of 120 ft. above high water level meant that the clearance under span 10 had to be increased by 83 ft. This clearance increase was obtained by two methods. The roadway profile was changed by jacking to increase the span 10 clearance by 50 ft., while the remaining 33 ft. was gained by replacing the deck span by a through truss span. (Fig. 2)

Roadway Profile Changes

As the elevation of the roadway on the tenth span was to be increased by about 50 ft., and, as the final roadway elevations should be the same at piers 9 and 10, it was decided to increase the elevation at pier 9 by 50.52 ft. and at pier 10 by 48.00 ft. (Fig. 3). A line joining the centre line of pier 14 at the original elevation and pier 10 centre line at the new elevation has a grade of only 3.80%. As a result, the centre line of pier 14 was chosen as the point of intersection between the old and new profile lines. A parabolic vertical easement curve 199 ft. long, placed symmetrically about the centre line of pier 14, was introduced.

South of pier 9, a maximum grade of 4.20% was specified. This is slightly less than the grade prevailing on either side of the main cantilever span.

This necessitated raising the roadway elevation at the south abutment by 26.83 ft. Since this abutment could not sustain the pressure of added fill, the bridge was extended by a new 65 ft. girder span and a new abutment. The old abutment was altered to act as a pier while still serving to retain the original fill.

A most important requirement of this contract was that the bridge remain in use for the duration of the work with an absolute minimum of interruption of traffic. It must be appreciated that this bridge, which constitutes a vital link in Montreal's traffic arteries, carries some 35,000 vehicles each day. In the interests of safety there was no alternative to stopping traffic for occasional short periods while certain delicate operations were in progress, and while the new tenth span was moved into place. Except in the latter case, all such interruptions were confined between the hours of 1 a.m. and 5 a.m.

One of the first operations necessary to maintain traffic flow while constructing the new south abutment, constructing the 65 ft. span, increasing the height of the old abutment, and placing the fill, was the provision of suitable traffic detours. For this purpose, diversions were constructed on both sides of the main bridge at the south end.

Temporary Diversions

The layout of the detour routes was governed by the south shore fill design, the traffic flow, and the work that had to be done while the diversions were in use. (Figs. 1 and 4.)

The space between the upstream and downstream diversion roads was designed to contain the additional 26 ft. of fill with side slopes of 1½ to 1. This placed the two routes on new fill either side of the old roadway with about 160 ft. clear between them. The Bailey bridges, and the portion of the temporary fill roads approaching them, were at the same elevation as the original bridge roadway.

Fig. 2 Aerial view of the Jacques Cartier Bridge—showing some work in progress on the south shore.

Fig. 1 Before and after view of bridge over channel.

Since 1955 the Jacques Cartier Bridge traffic has been travelling over a four lane roadway. With this in mind, it was decided to use four separate Bailey bridge lanes for the diversion, two on the upstream side for southbound traffic, and two on the downstream side for northbound traffic. In spite of a speed restriction on the diversions, they did not retard traffic flow more than the normal restrictions caused by bridge entries, exits and toll collections. The general design of the diversion layout was governed by the fact that the traffic had to be returned to the main bridge route after the alterations to the south end were completed, and before the roadway elevations at the turnouts could be altered. This meant that spans 1 and 2 must be jacked so that span 1 would reach its final elevation at the old abutment.

The reasons for adoption of a temporary grade of 7.51% on spans 1 and 2, meeting a reverse grade of 4.20% at the old abutment, need some explanation. Since the north end of span 3 is supported on the south end of span 4, which prevented any appreciable rotation at this point, the choice lay between temporary Bailey bridge routes 310 ft. long from span 3, or 580 ft. long from span 5. The latter, naturally, would have resulted in more moderate grades. The facts that re-routing of traffic from the turnoffs to the original bridge would take place in summer, that the steep grade could be rapidly reduced by the jacking of spans once the turnoffs were abandoned, and the obvious economy of the shorter routes, dictated their use. This reasoning was subsequently justified by the minor inconvenience to traffic during the relatively short period during which this condition existed.

Each of the two diversions consisted of duplicate Bailey bridge spans of 80 ft. triple-single and 110 ft. triple-double construction. These were supported on steel pile foundations at the South end and elsewhere on steel bents and towers anchored to concrete piers founded on rock (Fig. 5). All spans were designed to carry H20-S16 loading and provision was made for differential movements due to temperature between the bridge spans and the diversion structures. Generous turnoff curves from the bridge proper were established. Prominent warning signs, illuminated by night, were placed at intervals of 700 ft. and 100 ft. from the southbound turnoff.

The responsibility for maintenance of the steelwork and roadway was that of the Contractor, while policing, snow removal, and sanding was the responsibility of the National Harbours Board, who operate the bridge on behalf of the Dominion Government.

Southbound traffic was first switched to the southbound turnoff, after which the main bridge roadway was temporarily reduced to three lanes while the precast slabs of the recently added downstream lane were removed to allow completion of the northbound turnoff. During the seven months, from January to August 1957, that these diversions were in operation, when some 7,000,000 vehicles were handled, not one accident of a serious nature occurred. This speaks well for the planning of the engineer and cooperation of the National Harbours Board and the contractor in carrying out this phase of the work.

New and Old Abutments and 65 ft. Span

The new abutment, 68 ft. south of the old abutment, is the concrete gravity type. It retains fill which is 26 ft. higher than the old roadway, with a backwall 77 ft. wide. The wing walls are parallel to the bridge centre line and are about 40 ft. long. The abutment is supported on a spread footing on the old fill about 5 ft. below the original surface (Fig. 6).

The old abutment backwall was increased in height by 20 ft. 8⅞ in. to become the northern bridge seat for the 65 ft. span. This wall increase was 4 ft. thick and 77 ft. long. This new wall was dowelled to the old backwall with ⅞ in. diameter rods at 2 ft. centres 4 in. inside the north and south faces of the wall.

The original abutment bridge seat was 47 ft. wide and extended 4 ft. 4 in. out from the backwall face. As stage one jacking progressed, two pilasters were constructed to include the jacking blocks. They are anchored to the abutment backwall face with dowels and are 4 ft. 4 in. thick. Each pilaster is 12 ft. wide and they are placed 23 ft. apart between inner faces.

The 65 ft. deck plate girder span consists of eleven 5 ft. ½ in. deep riveted plate girders. These girders are tied together with top and bottom lateral angle bracing. Shims are placed between the shoe plates and girders in varying thicknesses to give the roadway crown of 2 in. The roadway is 60 ft. 2¼ in. wide and consists of an 8½ in. reinforced concrete slab. There is a 5 ft. sidewalk on each side of the roadway.

After the two abutments were completed, the 65 ft. span erected, and stage one jacking completed, the fill behind the new abutment was placed. On this fill, an exit route and an entrance route were paved up to the new abutment. In early August 1957, northbound traffic was again routed over the main bridge. While southbound traffic was still being diverted, the northbound turnoff was disconnected from span 3 and the bridge restored to its full four lane width by replacement of precast slabs. Southbound traffic was then routed over the bridge proper. At this time all traffic was moving over an unfavourable grade condition. Moving to the north, the profile was up at 4.20% over the fill and 65 ft. span, then with practically no easement, it turned down at 7.5% over the first two spans, then up again at the original 3.08% grade over pier 2.

As soon as possible, the upstream turnoff connection to span 3 was removed to free the span for jacking. Jacking then started immediately on piers 1, 2 and 3. Four weeks after the traffic was back on the main bridge, pier 2 had been increased in height by 7 ft. 8 in. and piers 1 and 3 about 4 ft. This relieved the unfavourable grade condition to the extent that the grades were now plus 4.20%, minus 4.4%, and plus 0.3% respectively.

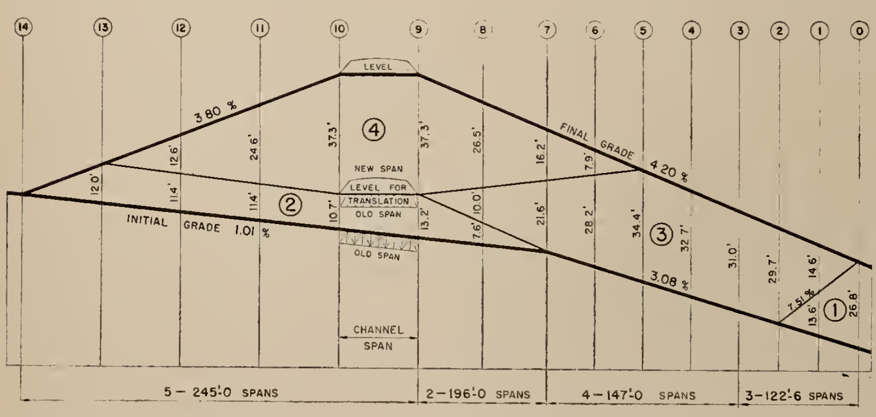
Jacking

The physical jacking of the bridge was divided into four main stages, as shown by Fig. 3. Stage one, as described before, was completed while traffic was on the temporary diversions. This stage consisted of jacking on abutment 0 and pier 1 only, and rotating about pier 2. The roadway at abutment 0 was lifted by 26.83 ft. to final elevation while pier 1 was lifted by 13.6 ft.

The second jacking stage was completed while the new span 10 was being erected. This stage was designed to bring span 10 to a level position for translation and to include enough work to keep jacking crews busy during the summer of 1957.

These four distinct jacking stages were designed so that not more than eight piers would be involved during any one stage in order to reduce the number of hydraulic jacks, pumps and hydraulic control systems needed. Confining the jacking to as few piers as possible during the winter

Fig. 3



PROFILE SHOWING FOUR MAIN JACKING STAGES months also reduced the heating problems connected with cold weather concrete pouring.

In order to discuss the jacking of thes pans, it is first necessary to describe the construction of the bridge with regard to bearings and jacking provision (Fig. 7). Each of the spans is supported by two Warren trusses at 40 ft. centres. The trusses rest on cast steel pier members at each end. These are either fixed bearings or contain expansion rollers. The top surface of each pier member is a convex spherical surface of 3 ft. radius, which fits into a concave surface of a dish plate riveted to the under side of the bottom chord. The positioning of the concave spherical surface on the dish plate is such that the spherical centre is vertically below the truss working point, or intersection point of the truss member centre lines. In this position the thrust from the pier member passes through the working point. This theoretical position will obviously change with variations in the roadway grade.

At each end of each span a heavy plate girder, known as a jacking girder, spans the 40 ft. between the truss end posts. The web of each girder is perpendicular to the truss chords. The jacking girder is stiffened and a bearing plate is riveted on the bottom flange 4 ft. inside the truss centre line. This serves as the jacking point.

The jacking girders were designed to support the dead load of the original bridge, with a three lane concrete roadway, allowing the usual 50% overstress for jacking. The roadway widening lane on the downstream side increased the dead load by 22% which necessitated the reinforcement of the jacking girders. It was not practical to reinforce for the added dead load plus live load at normal unit stresses. For this reason, traffic had to be stopped briefly during the night for these operations while the load was supported by jacks under jacking girders.

Heavy platforms were built around the circumference of each pier. These were suspended by wire rope from the bridge structure so that they would move up with the jacking. The height of the platform floor was adjusted to suit both concrete forming and jacking operations. A catwalk was constructed on the bottom lateral bracing for the full length of the working area to give access to each pier.

Fig. 4 Aerial view of Bailey bridges, new abutment, 65-ft. span and stage one jacking.

Besides structural strength considerations, one of the biggest problems during the jacking programme was geometrical control and planning for each lift. The basic lift was a height increase of 6 in. on all the jacks on one pier. To maintain roadway continuity, both spans resting on any one pier had to be lifted simultaneously. For stability reasons, a span could not be jacked at both ends at the same time. During a lift at one end of a span, the span rotated about the centre of the bearing sphere at the far end. In these deck spans, the height of roadway surface above the centre of rotation varies from 19% to 25% of the span length. For this reason, a 6 in. vertical lift at one end of a span moved the roadway deck longitudinally by about 1¼ in. The roadway expansion gap above the pier where jacking occurred opened by about 2½ in. while the gaps over the adjacent piers closed by about 1¼ in.

The theoretical roadway gaps on this section of the Jacques Cartier Bridge vary from 2¼ to 3¼ in. but over the years these roadway gaps have drastically reduced due to concrete slab elongation. In order to restore the total summation of gaps to the original figure, a total of 18 ins. of roadway had to be removed. This was done by cutting the deck slabs and roadway stringer extensions over several piers. To gain additional roadway clearance in certain regions while jacking, 1 ft. 2 in. of roadway was removed over pier 2 and replaced later. At pier 14, 1 ft. 5 in. of roadway was removed permanently during the easement construction so that the large rotation of span 14 could be made without risking a poor position of the span 14 pier members on pier 14. The length of the new span 10 was made to suit these various changes and the new length of roadway profile.

As the roadway gaps were opened by cutting, or as they varied by jacking rotations, traffic was carried on steel plates over the gaps or on timber fillers. These fillers consisted of 14 by 14 timbers spanning from the end floorbeam of one span to the end floorbeam of the other. Above these timbers were laid transverse 4 x 14's on edge filling the gap.

Each span lift of 6 in. was carefully planned in a particular order. This order was designed to prevent jamming of the spans at the roadway gaps, to reduce the number of longitudinal shifts of spans for geometrical changes, to give the most economical cycle of jacking, concrete pouring, and concrete curing, and to maintain good profile grades. The theoretical position of each span, both horizontally and vertically, was calculated for each jacking cycle. These geometrical calculations generally gave positions which were very close to those found in practice. In a few cases, however, the longitudinal position of a span did not conform to calculations. In such cases, the positions were surveyed and a new set of geometry was calculated for further operations from this base geometry. In cases where the jacking cycles could not be made to avoid jamming of the spans a longitudinal shift of a span was called for. The fixed end bearings were placed on a nest of cold rolled steel rollers between steel plates and the span moved longitudinally by hydraulic jacks. Where geometry calculations showed positions where the pier member thrust shifted too far away from the truss working point, the dish plates were changed. The moment of pier member reaction multiplied by the truss working point offset, after some rotation around the spherical bearing, was distributed to the truss bottom chord, end diagonal, and end vertical, in proportion to their rigidities. The secondary stress caused by this moment was allowed to reach 30% of the allowable before changing dish plates.

In the final position, each bearing point had new dish plates fitted to suit the theoretical permanent case. The dish and disc assemblies over pier 3 between span 3 and span 4 could not be removed as there is no jacking girder on the north end of span 3. As a result, the end posts and end diagonals of span 3 at pier 3 were reinforced.

As previously explained, the jacking cycles at pier 3 had to be such that spans 3 and 4 were kept very nearly in a straight line. The last panel of stringers for both spans rest on a common floorbeam. If the spans were too low at pier 3, the stringer ends would jam, while if too high, the sliding stringers would move off the floorbeam.

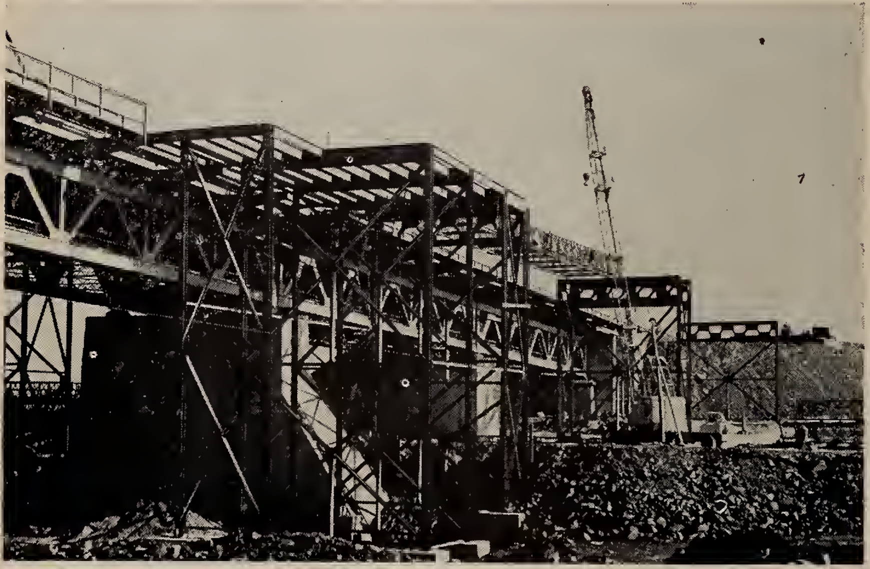
The jacking problem was somewhat complicated by the fact that the Bell Telephone Co. of Canada, and the Quebec Hydro-Electric Commission both have cable ducts on the bridge located just below the deck slab. Longitudinal geometry changes due to jacking necessitated continual moving and adjusting of the cables. Both organizations had men on hand throughout the jacking operations. As the 120,000-volt gas-filled electrical cables are very delicate, a catwalk was provided for the full length of the job beside the Quebec Hydro duct, giving access to every foot of cable. Both sets of cables come on the bridge from the ground at pier 1. Cable slack was stored at pier 1 to accommodate the additional height of the pier and the additional length of the new profile. Some of this slack was moved along the bridge as necessary.

The main jacking was done by using "climbing jacks" as shown in Fig. 8. These climbing jacks, 4 ft. 7½ in. high, replaced the pier members, which were about 2 ft. high, and it was therefore necessary to raise each span before they could be installed.

The preliminary jacking was done by lifting the spans with low height jacks under the jacking girders (Fig. 9). Usually two low-height jacks of about 200-ton capacity each were used under each jacking point. With various bridge grades the jack thrust must pass into the jacking girder in the plane of its web. The jacks were therefore set on two circular bevel plates and by rotating one bevel plate relative to the other, the grade of jack base could be adjusted to that of the span to be jacked. This method of jacking resulted in a slight horizontal thrust on the span. If the far end of a span being lifted was the expansion end, the longtitudinal movement was prevented by blocking and tying to the next span.

To avoid inconvenience to the travelling public, all preliminary jacking was done between 1 a.m. and 5 a.m. on Tuesdays to Fridays inclusive. During these hours traffic was stopped and the ends of the two spans on a particular pier, with all four pier members attached, were lifted. Aluminum shims, on account of their lightness, were used to follow up the span under the pier members. After about 10 minutes of jacking had elapsed, the spans were landed on the shims and traffic was allowed to resume. This process was repeated until the pile of ¾ in. aluminum shims could be replaced by a layer of 6 in. precast concrete blocks.

Fig. 5 Supporting steel for Bailey bridges and turnoff.



For the latter stages of the preliminary jacking, special hydraulic equipment which also formed the power portion of the climbing jacks was utilized. When the spans over a pier had been lifted high enough to receive a climbing jack, traffic was stopped between the hours of 1 a.m. and 4 a.m. The spans were then raised on the jacking girders by the special jacks and the retaining nuts locked. Pier members and supporting concrete blocks were then completely removed and the 4 ft. 7 in. high climbing jacks were put in their place (Fig. 10).

The heavy hydraulic equipment consisted of eighteen 500-long-ton jacks, twelve 400 long ton jacks, eight 4-cylinder electrically-powered pumping units, and sixteen hydraulic panels, each to control two jacks. The 500 ton jacks are 3 ft. 2½ in. long when closed and 22½ in. diameter, while the 400 ton jacks measure 3 ft. 1 in. by 20 in. They are double acting, that is, the rams are retractable under power. The rams are threaded for a retaining nut, designed to support the load when locked in any position. The jacks have an 8 in. stroke and operate under a hydraulic pressure of 5,600 p.s.i.

The pumping unit is designed with four cylinders on a single shaft driven by a 6 h.p. electric motor. Each of the four cylinders powered one of the four jacks on a pier. Thus with constant displacement, regardless of load, all four jacks on the pier raised at very closely the same speed.

The control panels provided each jack with a complete set of independent controls and relief valves. Oil from the pump passed through the panels on its way to and from the jacks. A control valve for each jack could be set in any one of four positions. The load could be held in any position with the oil returning to the pump sump. The load could be raised or lowered under control, or the jack could be put into a powered fleet to retract the ram. It was impossible to put the control lever to "Fast Return" while the jack was carrying load. Each jack was protected by relief valves for both main ram and annulus pressures, and the main ram pressure could be read at any time. The main ram line could be throttled for setting relief valves. A metering valve was in the circuit to control the speed of lowering under load, while a reflux valve prevented the ram falling by its own weight.

The "climbing jack" Fig. 8) consisted essentially of two parts, a heavy steel weldment, and a hydraulic jack with a steel base plate on its ram. The steel weldments were 4 ft. 7½ in. high, 5 ft. 5 in. long, in a direction perpendicular to the bridge axis, and 2 ft. 7 in. long in a direction parallel to the bridge axis. Each consisted of two side plates cut in the shape of an inverted U. These side plates were spaced 22¾ in. apart inside and were in a plane perpendicular to the bridge axis. On top of these two plates was a horizontal cap plate which supported the bridge bearing. On the bottom of the side plate legs were two horizontal bearing plates 16 in. wide by 2 ft. 7 in. long with a 2 ft. 9 in. space between them. Between the two side plates and perpendicular to them were two diaphragm plates 22¾ in. wide. These diaphragm plates ran from the centre of each base plate to points 22¾ in. apart on the underside of the cap plate.

The bridge bearing consisted of 6 in. diameter half round on the cap plate with its axis horizontal and perpendicular to the bridge axis. A special bearing plate rested on the half round. This plate had a 6 in. diameter cylindrical concavity in its underside and a 3 ft. radius spherical surface on top. The spherical surface matched the spherical cut of the bridge dish plate and allowed small lateral rotations for bearing adjustment. The 6 in. diameter bearing allowed very free rotation with the jacking and thus reduced the friction moments on the pile of concrete jacking blocks.

The space between the two diaphragms and side plates contained the cylinder of a hydraulic jack with its ram downwards. The base plate on the jack ram was 2 ft. 2 in. wide and 2 ft. 7 in. long and fitted between the two base plates on the weldment. When the jack was fully closed, its foot was 1 in. above the two weldment feet. By adjusting filler plates, every climbing jack weldment could accommodate either size of hydraulic jack. While in operation the hydraulic jack was firmly held in the weldment. The space inside the U shape of the side plates was such that when the outer feet were on 12 in. of blocking, the hydraulic jacks could be lowered by 12 in. and removed. Fifty climbing jack frames were made and placed under the structure at all points to be jacked while the thirty hydraulic jacks were moved from pier to pier for the four jacking stages.

Fig. 6 South bound Bailey bridge route, 65-ft. span and addition to old abutment.

As the climbing jack weldments actually became the bridge pier members for the length of the job, some were constructed with sliding Lubrite plates and used as expansion pier members. The sliding feet were made so that by tightening a screw at either end of the foot, the bearing could be locked in any position.

A stability strut connected each of the weldment feet to the bottom chord of the span at the first panel point. These were designed to stabilize the climbing jack in the longitudinal direction for expansion, contraction and traction. They were telescopic and could be locked to any length to suit the span grade.

Four types of climbing jack frames were made, heavy or light, and sliding or fixed. The heavy climbing jacks were designed to support 1,200 kips and the light ones were for 800 kips. The frames were designed to support these loads assuming a simple span between the two outside block piles.

The side plates and cap plates were made of U.S. Steel Co. grade T.1. steel using a design stress of 54,000 lb./sq.in. The diaphragms were made of A.S.T.M. grade A-373 steel, and the half round bearing of S.A.E. 1060 steel. All other portions of the weldments were of A.S.T.M. grade A-7 structural steel.

The choice of T.1 steel was based on several considerations. Its high strength, a guaranteed yield point of 90,000 lb./sq.in. and ultimate strength of 105,000 lb./sq.in., reduced the weight of a climbing jack frame by about 35% or about 1½ tons on a heavy type frame. This of course meant easier handling. This high strength also reduced the depth of the side plates at mid span which allowed the hydraulic jack to be removed while the frame was resting on two block layers instead of three. This meant better stability for a jack frame while the jacking work was proceeding at another section of the bridge. The side plates used were either 1¾ in. or 2½ in. thick. If the side plate depths were kept the same, the carbon structural steel design would require side plates more than 6 in. thick.

As these jacks supported the full weight of the bridge during the winter months, the low temperature notch toughness of T.1 steel was a desirable quality.

During fabrication of the climbing jack weldments, cracking difficulties were encountered when stress relieving at 1,150° F. before machining. The cracks appeared at the junction of weld and parent metal in many of the T.1 joints. No cracks appeared in the frames which were not stress relieved. The cracked frames were repaired and all were used without stress relieving.

The jacks were welded with a mild steel electrode (E 7016) except for joints of T.1 to T.1 where a high strength alloy electrode (E 11016) was used. Extreme care was taken to have smooth surfaces on all regions of high stress.

When the spans over a particular pier were to be jacked 6 inches, the procedure was as follows: If the far end of either span was resting on a sliding climbing jack, the sliding feet were locked to give longitudinal stability during the lift. All stability struts on both spans were loosened by about ⅛ in. to accommodate the length changes to be caused by rotation of the spans. The roadway gaps were checked for longitudinal clearance and the filler timber was adjusted, if necessary. Hydraulic pressure was simultaneously applied to the main rams of the four hydraulic jacks forcing the jack cylinders, the climbing jack frames, and the span ends upwards. The speed of travel was about 6 in. in 15 minutes. As the spans moved up, the jack travels were checked to keep the spans level laterally and the roadway slabs of the two spans at the same level. As the jack ram became exposed, the retaining nut was turned up against the jack cylinder, thus any possible hydraulic failure could not drop the span. As jacking progressed, aluminum shims were placed as a precaution under the outer feet to guard against lateral instability. The stability struts, although slack by a small amount, guarded the longitudinal stability. When 6 inches of the ¾ in. aluminum shims had been placed under the outer feet, they were replaced by 6 in. thick concrete blocks. These blocks were first placed under the feet closest to the bridge centre line during which time the outer shims were in position to resist any lateral forces on the ends of the spans. The outer blocks were then placed with the same safety. As the hydraulic jack centre of the climbing jack was stable by itself, the shims were really an extra safety device.

When all blocks were in place, the jack ram retaining nut was screwed down and the bridge lowered until the load was transferred to the jack frame. The ram and central foot was then lifted hydraulically and a 6 in. concrete block was placed under the base plate. Thus the spans had been lifted 6 in. and the jacks were in readiness for the next jacking cycle.

After the lift, the stability struts were locked at their new length, the sliding feet released, and the roadway gaps checked. Jacking operations then proceeded on another pier.

The precast concrete jacking blocks were of two sizes. The ones for the outer feet were 20 in. x 35 in. x 6 in., while those under the central feet were 28 in. x 35 in. x 6 in. They were designed for a vertical compressive stress of 1,200 p.s.i. The additional stressing from horizontal forces was low.

The blocks were made of 5,000 lb. concrete, reinforced with a cage of 4 in. x 4 in. No. 4 gauge welded wire fabric 1 in. inside all faces. They were cast, with hooks projecting from the edges to bond them to the pier mass, in machined steel forms. Accuracy was necessary because of high surface pressures, and all bearing surfaces were accurate to within 1/64th in. and the block thicknesses to within 1/32nd in.

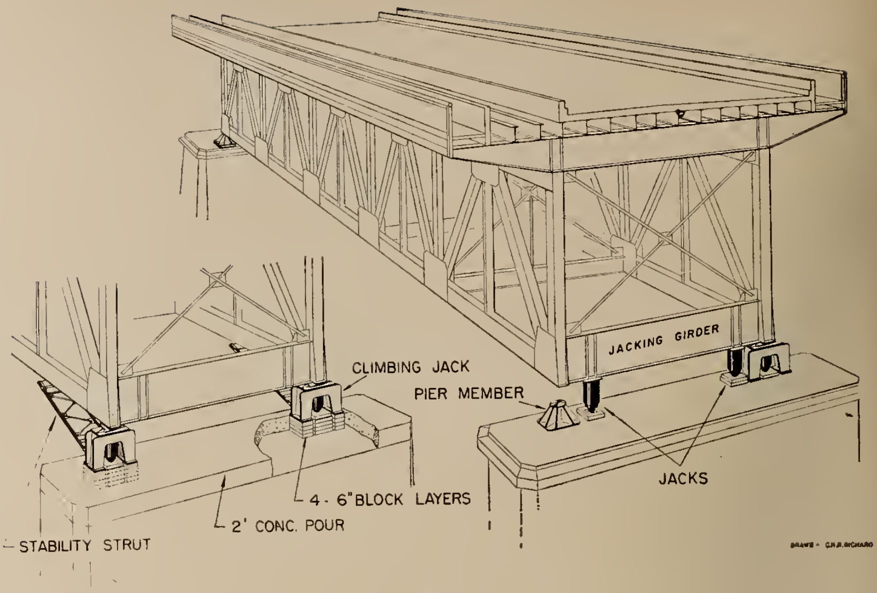


Fig. 7

When the spans over a pier had been lifted by 2 ft., that is, four layers of 6 in. jacking blocks had been placed under all the climbing jacks on the pier, a course of main pier concrete was poured around the jacking blocks casting them permanently in place (Fig. 7.) All the jacking blocks were tied together by reinforcing rods laid in the block anchor hooks and the main pour of 3,500 lb. concrete was reinforced by horizontal ⅝ in. rods at 8 in. centres near the pier faces.

Plywood forms were cantilevered from the last pour and during each pour form, anchors were cast in place ready for the next course of concrete. Before each pour, the forms were lifted and adjusted for the pier batter. During winter months the top sections of the pier were covered by heated plywood enclosures.

As the weight of the bridge was always carried by the piles of precast concrete blocking, the mass concrete surrounding the blocks did not have to be fully cured before further jacking.

Renewed jacking was permitted when the following conditions had been met: (1) The last pour had reached a strength of 1,500 p.s.i. or had cured for 48 hours. (2) The second to last pour had reached a strength of 1,500 p.s.i. (3) During winter months the pour becoming exposed below the heated enclosure had reached 2,500 p.s.i.

A Schmidt impact hammer was used for determining concrete strengths.

The final shape of piers was such that the pier tops were the same size as originally. The pier shaft batter was generally the same as the original 1 in 24. The original piers had to be thickened by about 1 ft. 6 in. on all faces. This was done the year before jacking work was started. This cladding concrete was bonded to the original pier by ¾ in. diameter dowels at 2 ft. centres, both horizontally and vertically, and reinforced with welded wire fabric.

Piers 12 and 13 were not increased in height by enough to merit thickening, but the original shafts were extended at the old batter. Four feet below the final cap, the shafts were enlarged to give pier tops of the same dimensions as the original ones.

To accommodate the new through span over the channel, with trusses 66 ft. 0 in. centre to centre, piers 9 and 10 had to be greatly enlarged. The tops of the original piers were 10 ft. by 50 ft. and were enlarged to 18 ft. by 84 ft. at the same elevation. After the spans were lifted to final elevation, tall pedestals were constructed on the upstream and downstream ends of piers 9 and 10 to support the through span trusses. The deck span trusses of spans 9 and 11 rest on these piers between the two pedestals.

Pedestals were originally provided to make up the differences in truss depths on piers 7 and 9. These differences were maintained during jacking operations by jacking the shallow spans from the pedestals and pouring courses of concrete on the pedestals each time a pier pour was made.

When the bridge over a particular pier had reached final elevation, the elevation of the top of the last block layer was found. The surrounding pier concrete was brought accurately to this level around the blocks. From this elevation and the required final pier top elevation, the capping block thickness could be calculated. These capping blocks, or bridge seat blocks, were a little larger than the pier member bearing area and about 18 in. thick. The block reinforcing protruded from the sides and was welded to the main pier cap reinforcing.

When the four capping blocks for a pier had been made and cured, a date for placing them was set, and the traffic was stopped during the night. The spans were supported on the jacking girders while the climbing jacks were removed. Two additional layers of jacking blocks were laid on soft grout over the old jacking blocks and surrounding pier concrete. The capping blocks were then put in place. The pier members were positioned and the spans lowered on to them. The last concrete pour was made flush with the top of capping blocks thus completing the pier.

Pier Fourteen Easement

The 199 ft. long parabolic vertical curve centred on pier 14 was designed to smooth the 4.81% grade change between the old 1.01% grade to the north and the new 3.80% grade to the south. The first construction operation was to deck a length of the upstream tramway lane with precast concrete slabs. This provided a temporary fifth lane so that further work on a lane of the main bridge roadway would still leave open four lanes for traffic. The easement construction work was done one lane at a time. The traffic was diverted from the lane and the roadway concrete slab was removed. The stringers were lifted and stools or fillers placed above the floorbeams and under the stringers to give the proper vertical curve.

The new deck consists of precast concrete slabs about 12 ft. by 6 ft. with the 6 ft. dimension being in the direction of the traffic. Steel anchor plates, cast in the underside of the slabs, were welded to the stringer top flanges. The roadway was then finished with an asphalt wearing surface.

Span No. 10

As mentioned before, the clearance increase was gained partly by changing the roadway profile, and partly by replacing the tenth deck span by a through span (Fig. 2.) The new through span is 248 ft. 0 in. long with trusses 66 ft. 0 in., centre to centre. The main trusses are eight panel, 40 ft. 0 in. deep, polygonal chord, Warren trusses with verticals (Fig. 11). The structure supports a 60 ft. 2¼ in. roadway between the trusses and two 5 ft. 1½ in. sidewalks outside the trusses. The deck is constructed with a 230 ft. vertical curve which serves as an easement between the final 4.20% and 3.80% grades. The floorbeams are Pratt trusses and vary in depth from 7 ft. 0 in. to 9 ft. 7-13/16 in. to suit the easement curve. The stringers are at 8 ft. 0 in. centres and span 31 ft. 0 in. They are 32 in. deep castellated beams made from 24 in. wide flange shapes.

Across the stringer top flanges are 10 in. I-crossbeams at 4 ft. 5⅛ in. centres. These crossbeams rest on various thicknesses of fills to follow the easement curve between floorbeams. The crossbeams are straight and the roadway crown is made in the 7 in. reinforced concrete slab.

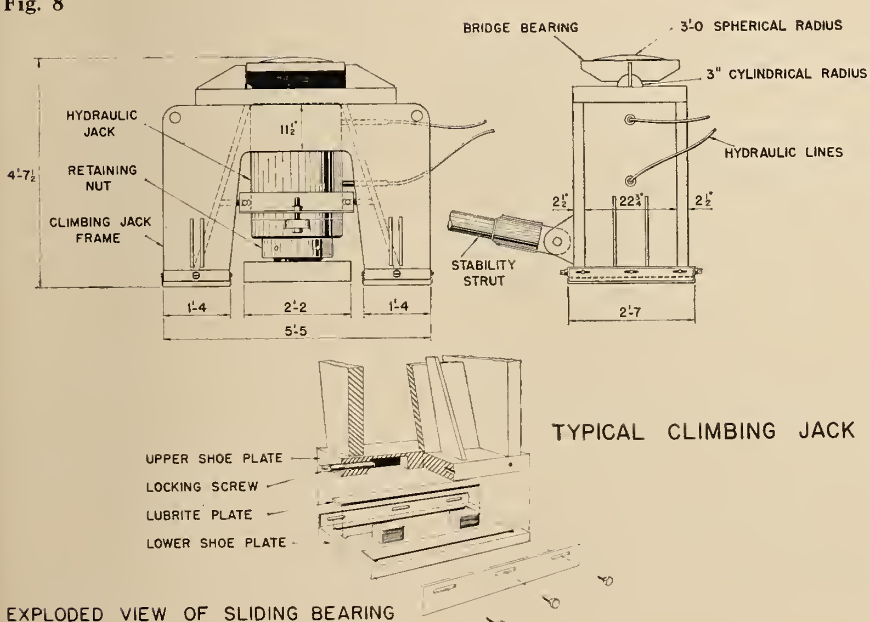
The end floorbeams are designed as jacking girders with jacking points 5 ft. 0 in. inside the truss. On each stringer line, there is a stringer extension bracket from the end floorbeam. These brackets were left off until the completion of jacking to give clearance for rotations and translation.

The span was designed to C.S.A. Specification S6 — 1952, except that the compression allowable was 20,000 - 70 l/r but not exceeding 18,000 lb./sq.in. The live load was two standard twenty-ton trucks and sixteen-ton trailers per lane spaced 48 ft. centre to centre. The live load stress for four trucks abreast was reduced to 83% while the other reductions were as per the C.S.A. specifications. All steel was medium carbon C.S.A.-G40.4.

In order to minimize interference with traffic, it was decided to erect the new span on falsework upstream of the bridge, tie the new and old spans together and roll them laterally, placing the new span on the bridge centreline and the old one on the downstream side. To conduct this translation of two spans at one time, it was necessary to have a common runway for new and old spans. To suit the old span, the runways were 245 ft.0 in. centre to centre and 45 ft. below the roadway surface. This required the provision of temporary steel legs on the ends of the new through span 35 ft. high and sloped to reduce the span length by 1 ft. 6 in. at each end. (Fig. 11).

These steel erection legs consisted essentially of main posts from the end truss working points to the runway bearings, bracing posts from the first interior truss panel points to the bearings, posts from the jacking points 5 ft. 0 in. inside and parallel to the main posts, and heavy bracing in the plane of the main and jacking posts. This bracing was designed for lateral wind and a portion of the dead

Fig. 8



and live load while the span was supported on the jacking point at runway level.

As the original truss depths changed over pier 9, there were 5 ft. high concrete pedestals under the bearings of span 9. The new span temporary legs at pier 9 were therefore made with a 5 ft. bottom section which was removable after translation. All four bearings on the piers were thereby brought to a common elevation for jacking after translation.

Translation runways were constructed upstream and downstream of piers 9 and 10. The runway centrelines were perpendicular to the bridge centreline and passed through the span 10 bearing points on both piers. The total length of upstream and downstream runway and the section over the pier top was about 220 ft.

During the channel construction, pier guard walls had been built from channel bottom around the foundation of piers 9 and 10. The top of the pier guards is 53 ft. above channel bottom. These pier guards were used where possible to support translation runway falsework.

Each runway consisted of seven rails at 6½ in. centres. The top of rail was 100 ft. above channel bottom and 45 ft below roadway surface. The rails were supported by either the pier top or four parallel steel beams. The beams were supported by 43 ft. high timber bents which rested on either the pier guards, pile foundations behind the pier guards, or 53 ft. high structural steel from the channel bottom. The runways were designed for a 400-ton concentration at any point.

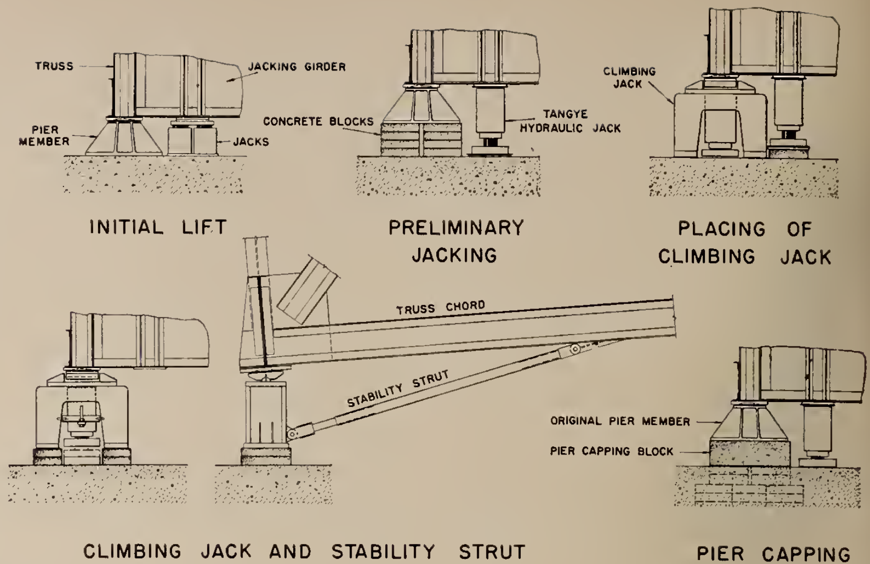


Fig. 9

During erection of the new span, the temporary legs and span ends were supported by the upstream runways. The interior panel points of the span were supported by timber falsework from the channel bottom. The erection falsework was 137 ft. high and was constructed in four tiers. (Fig. 12). The tier height was such that the top three tiers could later be used for falsework to dismantle the old span.

The bents for erection and runway falsework were fabricated during the winter of 1956/57 and erected by mobile crane during the spring and summer of 1957.

Fig. 10 Climbing jacks in place under the bridge trusses.

The new span and leg steel was erected with a 20-ton stiff leg traveller operating at the span deck level. The traveller was first erected by a mobile crane on falsework 90 ft. high located just south of pier 9 and upstream of the main bridge. After erecting the legs at pier 9 and the first floor panel, the traveller proceeded northward erecting the floor steel, bottom chords, and verticals of span 10. After reaching pier 10 runway, it moved back across the span and on to the traveller erection falsework erecting the top chords, diagonals, top laterals and portals (Fig. 13). When the steel erection was complete, the intermediate erection falsework was removed and the span was left supported on the two runways. The traveller was then dismantled and the traveller erection falsework transferred for use in the downstream runway.

The reinforced concrete roadway slab was formed, poured, and cured while the span was in this position. With the slab cured, the span was ready to receive traffic immediately after being moved into place.

The maintenance of electrical power and telephone service during the translation of the spans presented a problem which was worked out with the Quebec Hydro-Electric Commission and The Bell Telephone Company of Canada. In both cases, new lines had to be spliced into the circuits which ran from the top chord ducts to the bottom chord on spans adjacent to span 10. These temporary lines passed through ducts in piers 9 and 10 and across the Seaway channel below the spans being moved.

The telephone lines were more flexible and less likely to be damaged by movement and so were carried on wire ropes strung between the two piers. The Bell Telephone Company was able to store enough slack at piers 9 and 10 so that the final jacking elevation could be reached by the new span before splicing in the permanent cables on top chord ducts.

The electrical cables had to be placed on a steady platform as excessive movement might be harmful. In this case a double-single Bailey bridge supported on a steel bent at mid-channel carried the cables from pier 9 to pier 10. Immediately after translation, the cables were placed in the new span ducts and spliced into the main line.

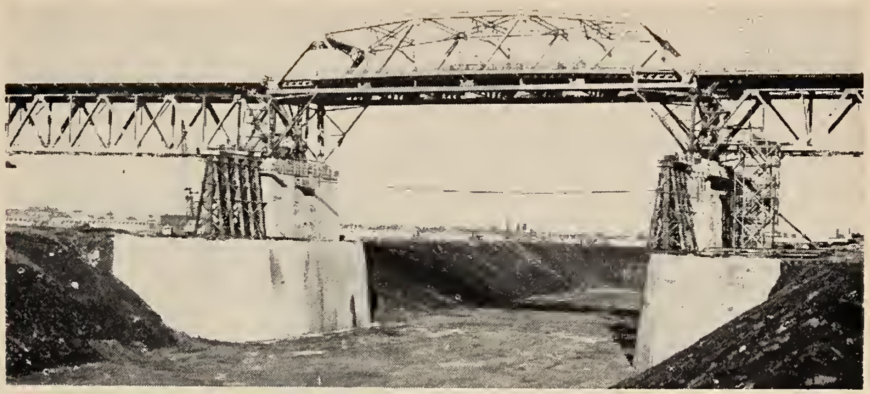
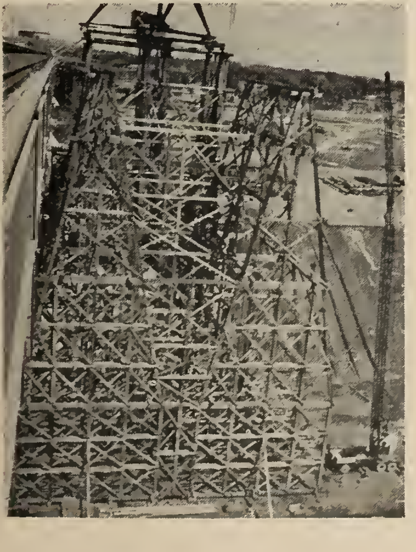


Fig. 11 New span in place on erection legs after removing old span and channel falsework.

During the translation, each of the two spans was carried on four roller trucks. The new span was constructed directly on its trucks. The old span, however, had to be supported on the jacking girders while the climbing jacks were replaced by piles of concrete jacking blocks, a heavy steel plate, seven parallel runway rails, and the roller trucks. Each roller truck contained forty-two 6 in. diameter steel rollers with bronze bushings running on 2½ in. cold-rolled steel axles. The axles were bored for greasing. During translation, the rails themselves were greased to minimize friction in the case of a seized roller. On the top surface of the trucks, were horizontal tongue plates which transmitted the pulling force into the truck and also on through to the trucks behind. The top surface of the tongue plate carried a spherical bearing for the span. Between the tongue plate and the roller truck were bronze plates to allow movement caused by span expansion and contraction and mal-alignment of the runways and span during translation. The two spans were tied together by heavy steel tie plates between the tongue plates.

The moving force was supplied by two horizontal hydraulic jacks, one jack at the downstream end of each runway (Fig. 14). Each 300-ton double-acting, 4 ft. runout jack was powered by all eight cylinders of two pumping units and one control panel of the vertical jacking equipment. A stand-by diesel generator was ready in case of power failure. With this hydraulic system, each jack had a capacity of 250 tons with a power stroke speed of about 10 in. per minute and fleet stroke speed of 24 in. per minute.

Fig. 12 Span 10 erection falsework.



The completed span.

During the power stroke each jack pushed on a cross-head which pulled a chain of links on either side of the jack cylinder. These links were 3 ft. 10 in. centre to centre of pins and connected the cross-heads to the downstream trucks on the old span.

The pumping units, control panels, and translation control centre were located on the downstream sidewalk of the old span. During every jack stroke, the movement of each jack was measured by a gauge at the jack ram. These readings were relayed to the control centre by telephone. The movements of each jack were recorded by moving pointers on scales for the benefit of the control engineer. As speed correction became necessary, the control engineer contacted either jack control panel by telephone. The roller trucks were inspected regularly and their condition reported to the control centre by telephone. When the jacks had reached the end of their stroke, a link and pin was removed from each chain and the jacks were fleeted so that the next link could be connected to the cross-head and another stroke started.

Traffic was stopped at 5 a.m. on Sunday, 20th October, 1957, and the roadway gap plates were removed. When this was done, the spans were started along the runways and were essentially in final position by 9.30 a.m. The spans were then accurately aligned and gap plates were placed across the joints over piers 9 and 10. Traffic was back to normal before 11 a.m.

During the operation a total load of 3,100 tons was moved 78 ft. (Fig. 15). Throughout the movement, the overall friction effects as found from the hydraulic pressures, was always below 10% of the moving load. No difficulties with alignment of trucks, spans or jacks or from falsework settlement were experienced.

Because of the dangers of ice and high water during the winter months, the St. Lawrence Seaway Authority had to start flooding the channel by December 1st. It was therefore necessary to remove the old span, all falsework, and the electrical cable Bailey bridge before this date. After the translation, the old span was blocked on falsework which had been transferred from the upstream side of the bridge and erected from the channel bottom. The concrete deck was first cut into sections about 4 ft. by 8 ft. with concrete saws and pavement breakers. The sections were lowered by crane to avoid damaging the falsework below.

After all slab had been removed, the twenty-ton stiff-leg traveller was erected on the span at the north end by means of a mobile crane. It backed to the south dismantling all the steelwork as it went. Connection rivets were cut out and all pieces were salvaged for possible re-sale. When the traveller reached the south end of the span, it was removed and the rest of the steel was cut into pieces small enough to be handled by crane from the ground. A traveller falsework was not used in this case as its cost was high compared with the loss of a few pieces from the old span.

The falsework and the Bailey bridge with its steel bent were removed and the channel cleared for flooding. The anchor bolts were cut off flush with the concrete base pads which were left in place as they had been poured flush with the channel bottom.

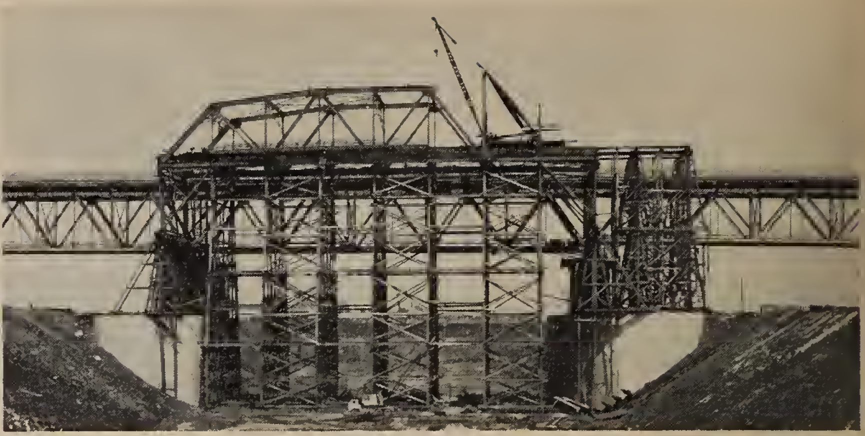


Fig. 13 Erection of new span 10.

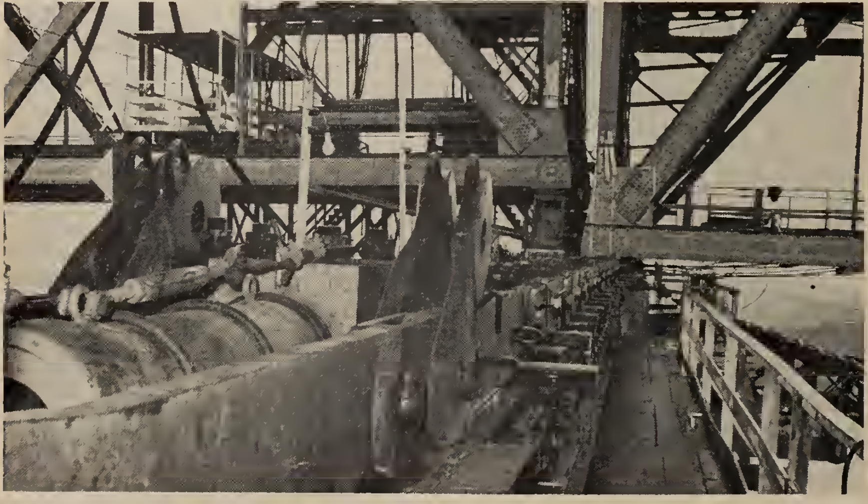
After final jacking of the new span 10, which completed all jacking operations, the concrete pier pedestals were cast around the temporary steel erection legs and the exposed steel bracing was removed. The permanent span pier members were already in place as the top sections of the erection legs. While the sliding type climbing jacks at pier 10 were free for temperature expansion and contraction, the pier 9 pedestals were completed and the roller pier members at that pier released. Then the pier 10 pedestals were poured. This construction method left one end of the span free for expansion at all times.

The St. Lawrence Seaway as a whole has been a most interesting engineering challenge and each section has presented its own particular problems. In the case of the Jacques Cartier Bridge modification there was, at times, some unavoidable inconvenience to the travelling public, as well as several novel problems to be solved. Solution of these problems for the successful completion of the work and reduction of interference with traffic to a minimum was only made possible by the excellent cooperation of all parties concerned. Chief credit must be given to the late Dr. P. L. Pratley, HON. M.E.I.C., who designed the orignal bridge and who also acted as consulting engineer to both the National Harbours Board and the St. Lawrence Seaway Authority in its modification.

Jacques Cartier Bridge is maintained and operated by the National Harbours Board on behalf of the Dominion Government, control being vested in Major Guy Beaudet, Port Manager, at Montreal.

Fig. 14 Below: Translation jack and pulling chain.

Fig. 15 Right: New Span on erection legs during translation.



INTERNATIONAL NEWS

TRAINING OF ENGINEERING PERSONNEL IN THE SOVIET UNION

The Soviet higher educational system is coping successfully with the task of training specialists of various types, but the biggest achievements have been registered in the training of engineering personnel.

In the USSR training for a higher technical education begins in the secondary school. The curricula of the Soviet secondary school are designed to give the pupil a general education of quite a high level.

The secondary school strives to foster in the children love not only for the humanities, but also for the natural and exact sciences, for engineering professions, for work in industry. Polytechnical training has been introduced for this purpose in many schools, where, together with the study of theoretical subjects, the pupils work in school shops, visit industrial establishments, get to know production and acquire some work skills. This is also facilitated by school circles of natural and exact sciences and also Olympiads arranged regularly in mathematics, physics, chemistry, biology, and other subjects.

The result of all this is that, in the USSR, engineering higher educational establishments have no difficulty in getting full enrolments.

In Soviet institutes, as a rule, there are three to four applicants for each vacancy. Those wishing to enter a technical institute have to pass competitive examinations in the Russian language, mathematics, physics, chemistry, and a foreign language. Those who reveal a higher level of knowledge are enrolled as first-year students. Knowledge is the only criterion for admission to a university or institute. True, some preference in enrolment is given to young people who have worked for two or three years after graduation from high school. But this by no means precludes the possibility of entering an engineering institute immediately after graduation.

Having young people who are sufficiently trained to continue studies and to master scientific and technical knowledge the Soviet state had to provide the conditions necessary for study. A wide network of technical higher educational establishments has been set up by the Soviet Government in a brief period.

The Soviet higher technical school system is represented in the main by two types—polytechnical and branch institutes. Polytechnical institutes hold an important place in the system of technical higher education. These are establishments with many departments which graduate specialists for a wide range of industries and in different specialties.

For example, the Leningrad Polytechnical Institute, one of the largest of its type, has nine departments: metallurgical, mechanical and engineering, electro-mechanical, power engineering, physical and mechanical, hydro-technical, radio engineering, and others. Each department unites related specialties. For example, the radio engineering department has the following specialties: radio-physics, industrial electronics, dielectrics, and semi-conductors. The metallurgical department trains engineers who specialize in the metallurgy of ferrous and non-ferrous metals, metallography, metal casting, pressure treatment of metals, etc.

Altogether this institute is training 10,500 regular students and over 600 evening students in 42 different specialties. The institute has a faculty of 870 professors and instructors. It has more than 200 laboratories equipped with the latest instruments which makes possible not only laboratory studies but also large scale research conducted by the faculty and the students.

Similar in structure are the other polytechnical institutes: Urals (13 departments, 36 specialties); Kharkov (15 departments and 38 specialties); Kaunas (7 departments, 18 specialties). In 1957 the Soviet Union had 29 polytechnical institutes with a total enrolment of over 195,000 students.

Another type of technical higher educational establishment is the branch institutes which usually train specialists for a definite branch of industry. Among them are metallurgical, mining, building, chemical, technological, and transport.

Mining institutes are very widespread in the USSR. The training of mining engineers has increased scores of times as compared with the pre-revolutionary years. Oil institutes and departments prepare specialists in the extraction and refining of oil and natural gas. Many institutes graduate metallurgical engineers. Some of them have arisen together with large metallurgical plants; for example, the Siberian and Magnitogorsk metallurgical institutes. Such educational establishments have been set up in Central Asia, the Caucasus, and other metallurgical centres of the Soviet Union.

Almost each Soviet technical institute is training mechanical engineers for different industries. In addition, there are a number of specialized engineering institutes. Up to forty institutes graduate electrical engineers, electrical mechanical engineers, thermal engineers, and radio engineers.

Soviet technical institutes also provide engineering personnel for the chemical, timber, paper, light, and food industries, and for the rail, river, and air transport services.

The number of specialties and departments in branch institutes is usually smaller than in polytechnical institutes. The Dniepropetrovsk Mining Institute which trains coal mining engineers has four departments: geological prospecting, mining, mining mechanical engineering, and colliery construction. The 3,800 students are trained in ten specialties. The Novosibirsk Construction Institute has five departments and seven specialties.

There are also a number of institutes in an intermediary position. The Moscow Power Institute, for example, while nominally being a branch institute, actually has ten departments and trains engineers of 26 specialties. The Bauman Higher Technical School of Moscow is closer to a polytechnical institute in its structure.

The number of technical institutes in the USSR, their nature and particularly their structure reflect the achieved level, needs and prospects of Soviet industrial development.

Instead of the sixteen technical institutes with a total enrolment of 22,000 students in 1914, Russia now has 200 such institutes with a student body of 785,000.

The graduation of engineers of all specialties is growing at a mounting rate. While in old Russia, 1,500 to 2,000 engineers were graduated annually, in the USSR about 30,000 engineers completed their studies annually before the war. In the first post-war (Fourth) Five-Year-Plan period (1946-50) 134,000 engineers were graduated and in the Fifth five-year period (1951-55) the number reached 258,000.

ISRAEL

THE TECHNION, Israel Institute of Technology, is a fully developed institute of university rank, offering undergraduate courses in engineering, architecture and the exact sciences, leading to the Bachelor's degree, and research facilities in basic and applied postgraduate studies leading to Masters' and Doctors' degrees. It also provides technical services and advice to Government and public bodies, as well as to Israel's industry and agriculture. The Technion was recognized by the first convention of the International Association of Universities, of which it has been a full member since 1951.

The Technion is an independent institution administered by a Board of Governors through an Executive Council. The supreme academic authority is the Senate, composed of the President, Vice-Presidents, full-time Professors and the Director of the Library. In the academic year 1956/57, the teaching and research staff numbered 440, and the student body 1980, including 220 students of the Evening Technion, as well as 150 postgraduate students.

Applicants for admission to the Technion must have a valid Matriculation certificate and must pass entrance examinations.

Faculties and Departments:

Studies are conducted within the framework of six Faculties and four Departments. With a few exceptions, the course of study is four years. During the first two years, students are offered general instruction in the basic sciences (mathematics, physics, chemistry and mechanics), as well as in technical drawing and selected fundamentals of engineering, on the level required for the advanced courses and according to the special needs of the Faculty, Option or Department. On reaching the advanced stage of undergraduate studies, the student is allowed to choose one of the options of specialisation offered, in accordance with his personal field of interest.

Faculty of Civil Engineering:

The general curriculum of the Faculty comprises Strength of Materials, Theory of Structures and Structural Design, Bridge Engineering, Soil Engineering, Building Materials, Hydraulics and Hydraulic Engineering, Sanitary Engineering, Surveying and Communications Engineering. Options offered are Structural Engineering, (advanced courses in Structural Design and Engineering), Hydraulic Engineering (advanced courses in Applied Hydraulics, Sanitary Engineering, Maritime Structures, Hydrology and Soil Science) and Public Works (advanced courses in Highway, Railway and Airfield Engineering). Laboratory facilities are available in Building Materials, Hydraulics, Soil Mechanics, Technical Climatology and Highway Engineering.

Faculty of Architecture:

The activities of the Faculty comprise the teaching of design in all its implications, ranging over the entire background of daily life (from objects for daily use to buildings and town and regional planning), adapted to the particular geographical, socioeconomic, technical and cultural requirements of the country. Options offered are Architecture and Town Planning. A Centre of Industrial Design, under the auspices of local and foreign bodies, was established recently within the Faculty.

Faculty of Mechanical Engineering:

Options offered are General Mechanical Engineering (advanced courses in Machine Tool Design, Lifting Machinery, Textile Technology, Industrial Machinery and Precision Manufacture), Power and Heat (advanced courses in Applied Thermodynamics and Design of Power Machinery) and Industrial Engineering (advanced courses in Organizational Methods, Costing and Budgeting, Production Planning and Economics). Laboratory facilities are available in Machine Tools, Metrology, Metallography, Industrial Research and Power and Heat Machinery.

Faculty of Electrical Engineering:

The general curriculum of the Faculty comprises Electrodynamic Fields, Electric Circuits, Electrical Machinery, Electrical Measurements, Fundamentals of Electronics and Production Engineering. Options offered are Electric Power Engineering, and Electronics and Telecommunications. Laboratory facilities are available in Electrical Machinery, Electrical Measurements and Electronics. A third option, Control and Servomechanisms, to include courses in Automatic Control and Servomechanisms, Network Synthesis and Computing Machines (including fields other than Electrical Engineering) is under way.

Faculty of Science:

Graduates of this Faculty are trained for scientific and research careers in academic institutions and industrial and Government laboratories, as well as educational careers in secondary and vocational schools. The Faculty also instructs students of other Faculties and Departments in the exact sciences. Options offered are Mathematics, Physics and Chemistry. Laboratory facilities are available in Physics, Inorganic, Organic, Analytical and Physical Chemistry, Mechanics and Rheology, and Solar Radiation.

Faculty of Chemical Technology:

Options offered are Industrial Chemistry and Chemical Engineering (including elective courses in Petrochemistry), High Polymer Technology and Advanced Chemical Engineering) and Food Technology and Biotechnology. Laboratory and pilot-plant facilities are available in Technical Analysis, Unit Processes, Industrial Control, High Polymers, Food Technology, Food Analysis and Quality Control and Industrial Microbiology.

Department of Agricultural Engineering:

Options offered are Soil and Water Conservation and Agricultural Structures (including Settlement Planning), and Farm Machinery. One term is devoted to courses in fundamentals of agriculture (Horticulture, Soil Science, Field Crops, Dairy Husbandry etc.) provided by the Faculty of Agriculture of the Hebrew University at Rechovoth.

Department of Aeronautical Engineering:

The curriculum is intended to provide a general theoretical and experimental background, with specialisation provided at the practical training or postgraduate stage. Laboratory facilities are available in Supersonics and General Aerodynamics, and Aircraft Structures and Materials.

Library:

The Technion Library serves as the main centre for technical information in Israel. It contains 55,000 volumes in the pure sciences, social sciences, engineering, chemical technology and architecture.

GERMANY

The Centenary of Structural Chemistry

Everybody is familiar with the structural formulae of organic chemistry, in particular the hexagonal benzene ring. Modern chemistry would never have been possible without these formulae. Yet structural chemistry is only 100 years old. In May 1858 a German chemical magazine published an article entitled "On the Constitution and the Metamorphoses of Chemical Compounds and the Chemical Nature of Carbon". Universities in Germany and elsewhere will commemorate this paper and its author when celebrating the anniversary this year. The author's name was Dr. August Kekulé von Stradonitz. His statue adorns the University of Bonn, where he lived and taught for a long time. Every chemical text-book in the world mentions his name.

Kekulé von Stradonitz came from a family of Hessian civil servants, but took to science. He was born at Darmstadt in 1829. Young Kekulé first studied architecture, but under the influence of Liebig he turned to chemistry. He studied in Paris, in Switzerland, and in London, where Frankland's and Williamson's ideas on chemical structure obviously influenced him.

Modest Beginnings

In 1856 Kekulé became a lecturer at Heidelberg University. A lecturer was not allowed to lecture at a university college or to experiment there; he had to lecture in his private apartment and establish his private laboratory outside the university precincts. The great Robert Bunsen, presiding over Heidelberg's Department of Chemistry in 1856, would never have permited a mere lecturer to desecrate the departmental premises by his presence, and last of all young Kekulé whose theories Professor Bunsen viewed with open disfavour all his life.

Anyhow, Dr. Kekulé had to rent an apartment in the house of a flour-dealer. Kekulé made one room into a "lecture-room" and shared it with another young lecturer who later became nearly as famous. His name was Erlenmayer: his flask is a household word to chemists all over the world. Another room was made into a laboratory. Despite Bunsen's misgivings a number of other Heidelberg lecturers soon gathered round young Kekulé. They included some names that were to reach international fame: Lothar Meyer, Beilstein, Carius, Adolf Breyer. Barely two years later Kekulé was appointed professor of chemistry at the University of Ghent, Belgium. He was 29 at the time. Another two years later he was famous enough to be able to call an international chemical congress at Karlsruhe.

This congress was a necessity. It is difficult nowadays to imagine the confusion reigning in those days within the ranks of chemists over such basic terms as "atom", "molecule", or "equivalent". Kekulé wanted to end this confusion by international agreement. Most chemists believed as late as 1860 that the formula of water was HO rather than H_2O, and the difference between an atom and a molecule was far from recognized. Under Kekulé's chairmanship the great Italian scientist, Cannizzaro, was able to convince the conference that the formula of water was really H_2O, that gases generally consist of molecules having two or more atoms, and that equal volumes of all gases at identical temperatures and pressures contain equal numbers of molecules. This had been taught by his countryman, Conte Amadeo Avogadro, half a century earlier, when this gifted amateur—he was in his chief occupation Napoleon's minister of finance in the Kingdom of Lombardy—had propounded this fundamental law of chemistry as a result of his spare-time studies in natural science.

August Kekulé had announced as early as 1856 that carbon was quadrivalent and that the symbols for the atoms elements such as C, H or O, needed only to be linked by dashes to give a faithful reproduction of the chemical structure of an organic compound. The formulae used prior to this may strike us today as most curious, yet professors taught them with iron severity and students had to recite them at their exams, with the faith of religious believers. With Kekulé, modern structural chemistry began, and it has progressed with gigantic strides ever since. Kekulé announced that two or more carbon atoms may "link up, mutually saturating their units of affinity", and as he found in 1862, they might even spend two such "units of affinity" on a mutual link, which constituted the fundamental discovery of the double bond between carbon atoms, leading to the "unsaturated" compound. Nowadays we no longer speak of "units of affinity", but simply say "valencies".

The discovery of the double bond gave Kekulé the key to the formula of benzene and the "aromatic" compounds whose number has become legion since. Chemists had hotly debated this formula. Kekulé announced that six carbon atoms are linked in the shape of a hexagon in the benzene molecule, a single and a double bond alternating. He gave experimental proof of his theory. He was quick to see that none the less all six bonds are equal, and tried to explain away the resulting contradiction by maintaining that the double bonds were oscillating between the carbon atoms. This hypothesis of oscillation met with stubborn opposition. The general ring formula was readily accepted by chemists, but they never entirely swallowed oscillation. Numerous other ring formulae were proposed, including those of Dewar and by Kekulé's own disciple, Baeyer; it became evident some seventy years after that each of them contained a grain of truth though none of them was adequate as a whole.

Today we know that the carbon bonds in the benzene ring are really equal; they are "one-and-a-half" bonds. Two of their three bonding electrons are part of a single bond while the third electron belongs to the molecule as a whole. Kekulé worked with purely chemical methods and relied on the inferences derived from them. He could not possibly know about such notions of modern science as electrons, dipole moments, polarization, vibrational and rotational spectra of molecules, the Raman effect and quantum mechanics. His intuition was all the more amazing, for our present six "one-and-a-half" bonds are in many respects equivalent to his three double and three single bonds, making a total of nine links. Half a year after Kekule's death (1896), Roentgen came with his X-rays, which Max von Laue began to use for chemical structural analysis in 1912. After this, structural research gained momentum. A. v. Werner had added a chapter on inorganic structural chemistry at the turn of the century, walking in Kekulé's footsteps. Modern atomic physics showed that atoms consist of a positively charged nucleus and negative electrons enveloping it; some of these effect the chemical bond by means of electrical attraction. Two decades ago the benzene molecule had been photographed with X-ray methods, and behold, it is a hexagonal ring with six carbon atoms linked by equal bonds. Yet Kekulé's formula with its alternating single and double bonds dominates many text-books to this day because the assumption of double bonds —though they do not really exist—facilitates the understanding of the chemical reactions of benzene.

Canadian Developments

NEWS OF MAJOR ENGINEERING DEVELOPMENTS IN CANADA

Railway Projects

P.G.E. Inauguration

The Pacific Great Eastern Railway, a 100 per cent dieselized system, is now an 800-mile route from Vancouver to Dawson Creek and Fort St. John, close to the Alberta border in northern British Columbia. The inaugural run on the completed line took place in October. P.G.E. has pushed north from Quesnel and south from Squamish at a cost of $96 million since 1949.

Communication on the railway is by microwave. Modernization of the older parts has been accomplished. Improved service has speeded deliveries to the coast by 48 hours. Car loadings soared from 12,482 in 1951, to more than 38,809 in 1957.

An immense development in this economic area has been forecast. Timber coal, wheat, minerals, livestock, produce are actual or potential freight from the north, with the prospect of secondary industries favourable. Manufactured goods and supplies are carried north to points where population has increased by up to 170 per cent in five years.

Canadian National Railways

Montreal: North America's largest automatic freight "hump" yard, in terms of capacity, is being built by the Canadian National Railways on an 800-acre site at Cote de Liesse, Montreal, for operation by 1961.

The $28-million brain will receive and classify daily as many as 7,000 freight cars and link them into groups of cars by means of electronics, radio, television and automatic computers. The entire operation will be controlled by personnel in six towers. The "hump" will have two tracks, which will switch cars to the 84 classification tracks in the main yard.

A $3.5 million diesel repair shop went into operation at the Cote de Liesse, Montreal, yards in August, 1958.

Winnipeg: In September a 4-year project was started to provide a $24 million freight hump classification yard at Symington yards, St. Boniface, to serve the greater Winnipeg area. It will be able to receive, classify, and despatch as many as 7,000 cars a day.

Centralized traffic control is being installed; duplication of repair facilities is eliminated; new shops will handle running repairs to diesel locomotives; and shops are being extended at Transcona.

Moncton: Another hump yard, of smaller proportions is under construction at Moncton at the cost of $15 million.

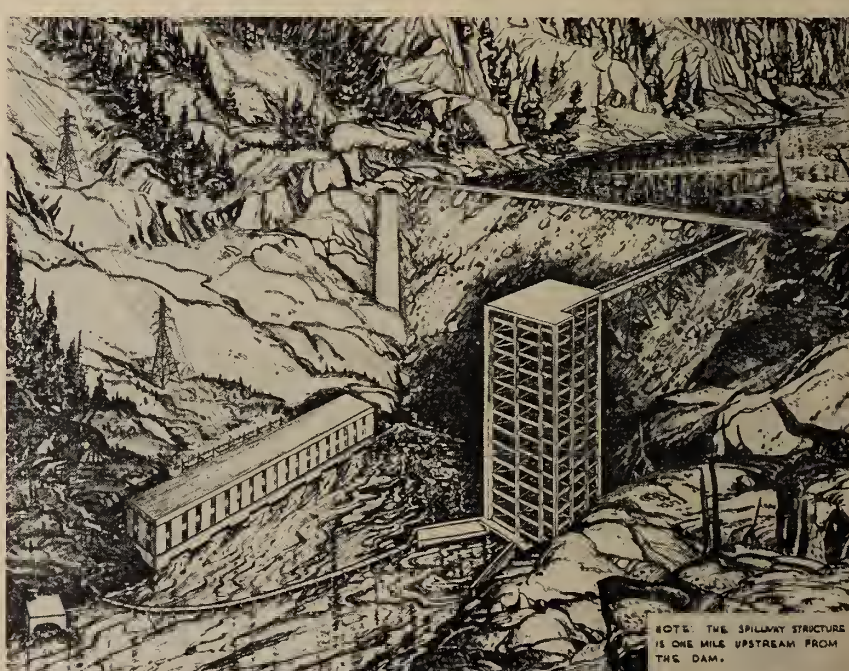
An estimated two million dollars will be spent in the Atlantic region during a two-year program to extend the centralized traffic control system westward. There are three stages: planned for completion in 1959, 1960 and 1961, the result being an automatic link from the seaboard to Montreal.

Further C.T.C. installations between Truro and Sydney, and on the other main lines in the Atlantic Provinces are also planned.

Helical Fishway

A new kind of fishway for various heights of dams has been developed jointly by Sir Alexander Gibb and Partners and Northwest Power Industries Ltd. Northwest is interested in the fishway for its proposed Nass River power project in B.C.

Rectangular or circular helical structure would be incorporated into the dam. Salmon ascend by a series of pools designed so that the lift from pool to pool is within their capacities. There are 12 travel pools in every circuit of the tower and a rest pool is provided in the centre for every circuit. The illustrated tower is 250 ft. high and has 14 circuits and a capacity of 2,700 fish per hour.



Model of Memorial University campus

Engineering at the Memorial University of Newfoundland

The Engineering Department at Memorial University College was started in 1930 with a staff of one lecturer and an enrolment of six students. The course set up then and still being given is a three year pre-engineering diploma course. From the beginning, as a University College, the institution has been an affiliated College of Nova Scotia Technical College, being represented on its Senate by the head of the Engineering Department and on its Board of Governors by the President. This affiliation still continues even though the Memorial University College was, in 1949, raised to the status of a degree granting institution under the name of the Memorial University of Newfoundland. Because of this affiliation the majority of the graduates from Memorial go on to Nova Scotia Technical College to finish their engineering degree, but they are not precluded from going elsewhere. "An increasing number are going on to McGill, and we have had students go on to Toronto, Michigan, and Massachusetts Institute of Technology to finish their engineering degree," Dean of Applied Science S. J. Carew reported.

The student enrolment in the Department of Engineering increased at a fairly even rate, with a slight peak after the war, until about five years ago when the rate of increase became rather large and the enrolment reached a peak of 154 in the year 1957-58. This same rapid rate of increase obtained in all faculties with the result that the existing facilities, although increased by the addition of temporary buildings, became rather strained and the decision was taken to make admission more selective thus keeping the total enrolment within manageable proportions. This accounts for the reduction in enrolment in the Engineering Department, which in the present year is 138.

As the student enrolment increased the staff of the department has been expanded by the addition of one new member in 1946 and another in 1954. The space allocated to the department was increased in 1954 and again in 1957. At the present moment the department has draughting accommodation for 45 students in the main laboratory, and for 35 students in the senior laboratory at one time, besides providing reading space for an additional 18 students. In the very near future a materials testing laboratory for concrete and hardness testing of metals will be in operation.

In 1956 a pre-forestry diploma course was instituted, closely geared to the requirements of the University of New Brunswick and the first diplomas were awarded in 1958. There has been a trend, since the granting of university status, for the better students to spend four years at Memorial and obtain a general B.Sc. degree as well as the engineering diploma. In this degree course a certain amount of credit is given for the purely engineering courses.

Looking to the future, the university has acquired a new site of about 100 acres and considerable work has been done in planning a completely new campus. For the first stage of the expansion — which consists of four buildings and will occupy about one sixth of the area — plans are already complete and it is hoped that construction will start in the near future.

The first of these buildings will house the administrative offices, alumni office, extension department, and the faculties of Arts and Education. The second building will house the departments of Physics, Chemistry, Biology, Geology, and Geography, as well as the Faculty of Applied Science which includes Engineering, Forestry and Household Science. Also housed in this building will be laboratories of some of the departments of Government, such as concrete testing, soils mechanics, and assay. The third building — the Library — has the usual reading rooms and library stacks. In addition the library building provides proper facilities for art exhibitions and for music appreciation. The fourth building will have a large gymnasium, which will also serve as an auditorium seating 1400, a swimming pool, squash courts, bowling alleys, a miniature rifle range and other athletic

A Report on Growth in the Engineering Faculties in Canada

Twelfth article of a series

facilities. Besides it will include offices for the U.N.T.D., the C.O.T.C. and the U.R.T.P., and a cafeteria. It is further hoped that hostels, which are included in the master plan for the new campus, will be started at the same time.

In the particular case of engineering, the department will, in the new building have facilities enabling it to handle about twice the present enrolment, as the laboratory space provided will accommodate about 150 students at one time.

The next stage of expansion envisages the faculties of Applied Science and of Education moving into new buildings, and so allowing Arts and Science to expand in the buildings of the first stage.

Acadia University

Acadia University, Wolfville, N.S., has a registration in three years of engineering totalling 139 this year.

Acadia is one of the Associated Universities giving three years of engineering studies in a program undertaken by a number of Atlantic Provinces universities. The students proceed to Nova Scotia Technical College for the last two years of engineering studies.

There is one building in the planning stage at the present time for Acadia University — a chemistry building. Souter Associates, a firm of architects located in Hamilton, Ont., are planning the building, in association with R. M. Peck, M.R.A.I.C., of Wolfville, N.S.

Saint Mary's University

By 1959 Saint Mary's University, Halifax, N.S., will increase its classroom facilities by twenty per cent. This will be made possible by allocating to the university class-room space now used by the high school. Other accommodation is being found for the high school.

Saint Mary's now has a registration of 95 in the three years of engineering. It is one of the Associated Universities, whose students traditionally proceed to Nova Scotia Technical College after completing third year.

Apart from staff increases and normal acquisition of equipment, no major addition has been made to the facilities of the engineering department.

In the next five years it is planned to erect a building to house some of the sciences and possibly engineering. This project is still in the tentative planning stage, but its need is urgent.

Expansion at the University of Western Ontario

The Department of Engineering Science was established at The University of Western Ontario in 1954, to offer a two-year course designed to prepare students for admission with advanced standing to certain engineering courses at other Canadian universities. At that time, it was thought that an expansion of the program would be considered in 1959 or 1960. The initial policy was to admit not more than 30 students to the first year.

The new department became, and still is, one of the departments of University College. The Faculty of Arts and Science consists of University College and a number of affiliated colleges. The well-known School of Business Administration was a department of University College until 1950.

A philosophy of what engineering education should be in the second half of the Twentieth Century was formulated at the University before the department was established. This was done in consultation with a small group of professional engineers and executives who acted as an advisory committee. The principles adopted were essentially the same as those proposed several years later in the Report on the Evaluation of Engineering Education (the Grinter Report) by the American Society for Engineering Education.

In 1956 the Board of Governors authorized (a) the expansion of the course to a four-year one leading to a degree, and (b) the planning of the Engineering Science Building. The following decisions were made before any plans were prepared: (a) the first-year enrolment was to be limited to 150 students, (b) all instruction in physics, chemistry, mathematics, geology, the humanities, and the social sciences would be given by the departments concerned and neither lecture-room nor laboratory accommodation would be required in the building for work in these subjects, (c) for a number of years, the Department of Physics, which had the staff and the equipment, would be responsible for the high-frequency electrical field, and (d) the laboratories in the new building would be suitable both for undergraduate work and for a modest program of staff and graduate research.

The preliminary plans were completed in May 1957, the detailed plans and specifications were completed in December 1957, and the contract was awarded and construction started in January 1958. The building will be ready for occupancy about the end of April 1959. The cost of the building, including furniture, will be about $1.40 million and the cost of laboratory equipment will be about $0.35 million.

The exterior of the building is of rough stone and matches the other buildings on the campus. There are three floors and a penthouse for the ventilating equipment and the elevator hoist.

The building contains laboratory facilities for work in mechanics of materials, soil mechanics, fluid mechanics, thermodynamics, photoelasticity, vibrations, unit operations and chemical pilot-plant studies, electric machines, and electric control systems. In addition, the building contains lecture rooms, problem or computing rooms, draughting rooms, a reading room, a conference room, a departmental office, staff offices, a shop for the fabrication of laboratory and research equipment, and considerable storage.

An Advisory Commitee on Engineering Science was appointed in 1957. This committee consists of four members of the Board of Governors, the President, the Principal of University College, about fifteen engineers who are recognized for their professional and managerial abilities, and the head of the Department of Engineering Science. The Engineering Institute of Caanda is well represented on the committee.

The departmental shop has been set up in temporary quarters and some laboratory equipment has been installed temporarily in existing buildings. More laboratory equipment will be installed temporarily during the present academic session.

During the 1958-1959 session the staff consists of a professor, two associate professors, two assistant professors, two lecturers, a secretary, and a technician. Six engineers, who are graduate students in the School of Business Administration, are part-time members of the staff.

The present first-year enrolment is 80 and the total enrolment is 155.

The development of a program in enginering education is only one phase of the expansion of the University. Since early in 1954 the following buildings have been constructed: Stevenson Hall, which contains the administrative offices of the University; Somerville House, which contains a dining hall, a snack bar, and other facilities; the Richard G. Ivey School of Business Administration Building; and the Biological and Geological Sciences Building. A men's residence, which will contain a dining hall, for 300 students will be completed in 1959.

It should be noted that graduate enginers form the largest group of students in the two-year course leading to the M.B.A. degree in the School of Business Administration. As mentioned above, six members of this group are part-time demonstrators in the Department of Engineering Science.

Engineering Science Building under construction at the University of Western Ontario.

Aid to Education

Three sources of information on aid to education are available.

Industrial Foundation on Education

A survey of higher educational institutions has recently been completed, and information from this has been published by the Industrial Foundation on Education, Toronto (170 University Ave.), under the title "The Case for Corporate Giving to Higher Education (1958 Supplement)".

This report studies the performance of business and industry in this field for the academic year ending in 1957. It is the second edition of the report.

The October 1958 news letter of the Industrial Foundation on Education, commenting on the survey, is abstracted as follows:

"The most startling information in the current report is the phenomenal increase in the amount of money given by corporations in 1957 over 1956. This increase was nearly 4½ times—increasing from 2.7 million dollars to 11.6 million dollars."

Chart No. 1 of the report indicates that between 1946 and 1957 corporate giving increased at a much more rapid rate than either university enrolment or university capital and operating costs. Enrolment increased to 1.75 times the 1946 figure and costs increased 3.37 times what they were in 1946. Over the same period corporate financial aid to universities increased by nearly eight times the amount given in 1946.

Corporate giving to universities expressed as a percentage of profits before taxes amounted to .083 per cent in 1956, and .384 per cent in 1957, or 4.6 times the 1956 percentage.

The corporate grants accounted for 9.2 per cent of the capital and operating costs of universities in 1957. This almost amounts to the Foundation's originally suggested formula for total corporation giving, that is, providing 10 per cent of corporation profits before taxes.

Nature of Expenditures Associated with Grants

In the survey, grants from two major sources were considered: those from business and industry, and those from foundations established by industrialists. Approximately 75 per cent of the total were found to originate from the former, and 25 per cent from the latter.

The analysis by type of grants shows by far the largest proportion going for capital purposes (61 per cent). Grants for operating purposes constituted 8 per cent; for research, 11 per cent; and for unrestricted and unclassified purposes, 20 per cent. The large proportion provided for capital purposes was evidently encouraged by the well managed and informative campaigns conducted by the universities during the year, and is further evidence that business responds well when the need is made known.

Distribution of Grants—by Region

Considerable variation in corporate giving expressed as a rate per student enrolled was indicated between various regions in Canada. For the two years 1956 and 1957, the giving per student in the various regions was:

	1956	*1957*
Western Canada	$26	$60
Ontario	48	148
Quebec	15	240
Maritimes	105	94

In total, the rate per student for all Canada was $38 in 1956, but rose to $149 in 1957.

Grants from Canadian and Foreign-Controlled Companies

In a News letter earlier this year, the Foundation reported that foreign-controlled companies in Canada contributed a much larger proportion of the student aid funds in this country than do Canadian-controlled companies—$687,775, or 67.1 per cent of the total compared with $337,020, or 32.9 per cent of the total by Canadian companies.

However, for the much larger amounts covering grants made directly to universities the percentages are reversed. Foreign-controlled companies in Canada contributed $3,280,441 or 30 per cent of the total, while Canadian-controlled companies contributed $7,652,947, or 70 per cent of the total corporate grants. The comprehensive total — student aid plus grants direct to universities and colleges — show Canadian-controlled firms contributing 66.8 per cent and foreign-controlled 33.2 per cent.

Dominion Bureau of Statistics

Undergraduate Awards

An important, comprehensive source of information about undergraduate scholarships and bursaries is the publication "University Entrance Awards". This is published by the Dominion Bureau of Statistics, Education Division, and sold by the Queen's Printer at cost of $1.00. The latest edition, a revision of "Reference Paper 55", brings the information up to date as of February 1958, listing awards not previously listed, and giving more complete coverage of awards by professional and service organizations and by business and industry.

The awards listed are limited to entrance scholarships and bursaries valued at $100 or more. Most of the institutions included also have various loan funds and in--course awards, details about which can be found in the calendars of the individual universities or colleges.

The information, being comprehensive, refers only in part to engineering education.

Graduate Awards

"Awards for Graduate Study and Research, 1957" is the title of a 158-page report published by the Dominion Bureau of Statistics, a revision dated December, 1956. It is available from the Queen's Printer at price of $1.00.

As in the past, awards open to Canadians from sources in Canada and abroad are included. Wherever possible, a notation has been made to indicate whether or not Canadian awards are also open to persons from outside Canada.

In this edition there is an increase in entries from outside Canada, principally from the United Kingdom and the United States.

In so far as it is available, information about part-time assistantships in the various institutions, and information on research grants, has been included.

St. Lawrence Seaway and Power Project

Early in November 1958 many signs could be observed that the construction phase of the billion dollar St. Lawrence Seaway and Power Project was nearing completion.

Though close to 7,800 persons were still employed and work costing many millions of dollars remained to complete, most of it consisted of underwater dredging and 'sweeping' of channels, steel erection, and the installation of electrical and mechanical devices required to operate lock-gates, lift spans on bridges, or of turbines and generators. Apart from the dredging which would be closed down for zero weather, most of the machinery installation would continue throughout the winter months.

On the Canadian half of the international power-house all construction cranes were dismantled, the last two cells of the cofferdam were removed, and seven units were operating. Cleaning up and sweeping of channels upstream was nearing completion as scheduled, and work would continue next summer. Employment stood at 1600 persons.

On the American half of the powerhouse 4,600 yards of rock had been removed from the tailrace. Seven units were operating and another undergoing tests. Concrete was all placed on the Long Sault dam and permanent hoist erection nearing completion. Upstream dredging of channels was completed and sweeping was continuing.

Dredging of the north Cornwall channel was shut down, but excavation to widen the channel, and removal of cofferdams would continue. The international high-level highway bridge at Cornwall was opened for traffic on December 1. Employment by NYSPA stood at some 2,300 persons, while the force employed by SLSDC stood at close to 400 persons.

Progress by SLSA

At the Beauharnois locks, rock excavation between the locks was completed while sills for the mitre gates in the upper lock were nearing completion. Water was let in to the intermediate pool. As on the St. Lambert and Cote Ste. Catherine locks, installation of machinery and testing would proceed during the winter months. Upstream and downstream cribs were in place.

On the Jacques Cartier bridge, permanent approaches at the south end were carrying traffic, with only the toll portal structure still under construction. On the Honore Mercier bridge the northbound lane of the Valleyfield approach was erected and paved but not yet opened for traffic. All lanes were expected to be opened for traffic by end of November. At the Victoria bridge, seven spans on the railway diversion on the upstream side north from St. Lambert were erected and being riveted, leaving three spans nearest to the St. Lambert lock to be erected. Work was continuing on erection of the tower for the lift bridge over the lock.

Employment by SLSA stood at approximately 3,500 persons at month-end.

The South Saskatchewan River Project

With the signing of a Federal Provincial agreement at Ottawa on July 25 between Canada and the Province of Saskatchewan, the stage was set for preliminary construction work on the South Saskatchewan River Dam. Overall cost of the project is estimated at $182 million. The Federal Government will pay $72 million towards the cost of the dam, estimated at $96 million. It will also lend Saskatchewan $12 million for its 25 per cent share of the cost of the dam. The cost of power and irrigation works, amounting to almost another $90 million, will be borne by the provincial government.

Preliminary work under way

Early in October a contract was awarded to the Evans Construction Co. for building 12 miles of access roads to the dam site at a price of $172,000. Early in November, MacNamara Ltd. was awarded a contract for processing aggregates at $812,000, and Beatty Ramsey Construction Co. was awarded a contract for headquarters services at the damsite. Tenders were asked for headquarters buildings. Further bids would be called soon for rockfill bridge abutments, piers and a bridge superstructure. Some $4.5 million was allocated by the Canadian government for the current fiscal year. Most of the bids will be asked in the spring.

A modern village, to have a population of about 200, will be laid out and built on the east bank of the South Saskatchewan river, near the site of the proposed 210 ft. high earthfill dam. It will have gravelled streets, concrete sidewalks, sewers and a water distribution system. This village will contain the offices of the P.F.R.A. engineering and construction supervisory staff, with living quarters for them and their families. No stores, service stations, churches or schools will be built. Streets and services will be completed by late December.

Geraldton in time for this year's heating season. The Company commenced service in Port Arthur, Fort William and Dryden last year.

Northwestern Utilities: Delivery of gas from the Pembina field to Edmonton started October 31, following testing of the 70-mile, 16-inch pipeline of Northwestern Utilities, Limited. This new pipeline will make it possible for gas consumers in Central Alberta to utilize gas which was formerly flared. About 50 million cubic feet of gas a day will be delivered initially, enabling Northwestern Utilities to conserve its own gas reserves for meeting severe winter demands.

Saskatchewan Power Corporation: Steelman Gas Ltd. officially opened its casinghead gas processing plant in southeastern Saskatchewan on October 30. With capacity of 30 million c.f.d. it is starting off with production of 25 million c.f.d. Gas formerly flared off as waste from more than 600 wells will be collected through the gathering system. First call on the gas will be given to cities of Estevan and Weyburn.

F. P. C. rejects Trans-Canada gas: The Federal Power Commission on October 31 rejected Midwestern Gas Transmission's application to import Canadian gas at Emerson, Manitoba. Its decision was based on the fact that Trans-Canada had not contracted for sufficient reserves to satisfy both Canadian customers and the U.S. market. Turned down also were the competing applications from Northern Natural Gas and Michigan Wisconsin Pipeline Co. But the way was left open for new applications from all three for projects "conceived realistically on the basis of natural gas needs", in the upper middle west area.

Canadian Pipeline Projects

Canadian pipeline construction in 1958 will total some 4,200 miles, — the second largest annual pipeline construction season in Canadian history. Biggest job was the Trans Canada system between Lakehead and Toronto, on which 12 spreads worked on a continuous section of 853 miles including the Crown Corporation section from Lakehead to Kapuskasing. Other natural gas mileages included: Westcoast, 200; Alberta Trunk, 237; two Alberta Utilities, 270; Saskatchewan Power Corporation, 475; Northern Ontario Natural Gas, 270; Union Gas, 400; Consumers Gas, 400; Lakehead 150; and Quebec Natural Gas, 100; for a total of 3735 miles of gas pipelines. Some 482 miles of crude oil pipelines were under construction in the prairie provinces, inclusive of 82 miles of looping on Interprovincial.

Westcoast Transmission

Westcoast Transmission and Alberta and Southern Gas Co., have announced plans for joint construction and use of single gas pipeline from the Alberta border to the B.C.-Idaho boundary. The line will be owned and operated by Alberta Natural Gas Co. Initial cost will be some $40 million. Each export company will continue to purchase gas from Alberta distributors independently from one another.

Delivery of gas from the Blueberry field in the Half-way area of northern B.C. started in mid-October through Westcoast's $7 million gathering system with initial deliveries of 15 million c.f.d. Deliveries will ultimately be stepped up to 50 million c.f.d. by 1960.

Trans Canada Pipelines

Final testing of Trans-Canada Pipe Lines' natural gas line from Alberta to Montreal was completed October 23, and approval from the Board of Transport Commissioners received. The final testing took place between Hearst and Kapuskasing. It was completed well ahead of schedule when the final weld was made near Kapuskasing October 10. Natural gas from Alberta arrived in Toronto the following day and then moved through the line to Ottawa and Montreal.

During the 1958 construction season, 5,000 men built the final 852 miles of the line, working east from Port Arthur on the Northern Ontario Pipe Line Crown Corporation section of the line, and north from Toronto on the Trans-Canada section.

Northern Ontario Natural Gas Co.: Natural gas arrived in Northern Ontario in mid-October.

Also nearing completion were two small lateral supply lines built by Northern Ontario Natural Gas to carry gas from the Trans-Canada line to Timmins and to Sudbury.

The Company holds a contract to supply an initial six million cubic feet of gas daily to the International Nickel Company plant in neighbouring Copper Cliff. Eleven pulp and paper mills in the area are also large users.

Northern Ontario Natural Gas will distribute natural gas in the following communities this year; Orillia, Gravenhurst, Bracebridge, Huntsville, Sturgeon Falls, Sudbury, Copper Cliff, Cobalt, Haileybury, New Liskeard, Englehart, Kirkland Lake, Porcupine, South Porcupine, Timmins, Schumacher, Ramore, Matheson, Ansonville, Iroquois Falls, Cochrane, Smooth Rock Falls Kapuskasing and Hearst. Service has been available in Kenora since last year.

Northern's affiliate, Twin City Gas Company Limited, will commence service in Red Rock, Nipigon and Geraldton in time for this year's heating season.

Design Competition

Fifteen awards totalling $44,000 are offered to engineers and engineering students in a competition open to Canadians. Sponsor is the United States Steel Export Company, 100 Church Street, New York 8, N.Y.

The competition poses the problem of designing an overpass structure in steel to carry a two-lane highway at right angles over a four-lane highway on level ground. Standards of the American Association of State Highway Officials and the U.S. Bureau of Public Roads will be regarded.

First award for engineers is $15,000; first award for an engineering student is $9,000. All entries will be judged on the basis of originality of design, utilization of the properties of steel, economy, and appearance.

Information and rules may be obtained from the Company at the above address, or from the American Institute of Steel Construction, 101 Park Avenue, New York 17, N.Y.

Month to Month

News of the Institute and the Profession

COMMENT
CORRESPONDENCE
ELECTIONS
AND TRANSFERS

CONFEDERATION—A Progress Report

The Institute panel of the sub-committee on Confederation met again in Ottawa on November 4 with Messrs. Tait, Foulkes and Wright present. The proposed report of the sub-committee was completely reviewed with the object of clarifying and more clearly defining the wordings. A final version was agreed upon.

This report was sent by the Institute to the Canadian Council's panel on the sub-committee on November 7, with the request that approval or changes be indicated as soon as possible.

In response to a telephone call from your chairman on November 18, Mr. Fox stated that the report was satisfactory to the three members of his panel of the sub-committee except for one slight alteration.

As our three panel members of the sub-committee agreed with this proposed change, the alteration has been made in the report and copies have gone to all members of the Committee on Confederation on November 26. Mr. Fox planned to send copies to the members of his committee and accordingly an adequate number of copies have been sent to him at the same time as they were sent to the members of the Institute committee.

It has been agreed with Mr. Fox that replies from all members of the joint committee must be back in the hands of the chairmen by December 12, and for those who do not reply it will be assumed that they are in agreement.

It is hoped that the report will be acceptable to all committee members and that within a very short period of time it will be submitted to the two councils.

It is a matter of satisfaction to your chairman that unanimity of approval has been given by all six members of the sub-committee. This is an encouraging sign which it is hoped may indicate the reception the report will get from the two councils and eventually from the general membership.

IRVING R. TAIT, HON. M.E.I.C.
Chairman
COMMITTEE ON CONFEDERATION

1958 University Registration

Once more the Institute has completed its annual survey of registration in engineering at Canadian universities. These figures have been obtained direct from the registrars across the country, and a tabulation of them in detail is given on pages 67, 68, 69 of this issue.

Readers will interpret these results in different ways in accordance with their varying points of view. However, certain facts stand out and some editorial comment therefore seems appropriate.

Perhaps the most important figure to examine is the grand total of the enrolment. This now stands at 14,552 as compared with 14,247 a year ago. This increase, slightly over 2 per cent, is the smallest rise to be reported for quite a few years. Causes for this could be sought, but it is not considered to be too significant for the reason that new and improved university facilities on many campuses are expected to swell the total again soon.

Observers of these trends are always interested in the statistics of new freshman intakes. This year's survey discloses a sharp drop in the number of new engineering students starting their courses this year. The total new class numbers 4,572 against 5,132 last year, a decrease of 11 per cent. This does not reflect a very healthy condition for the profession. At least in part, this must be attributed to general economic conditions this year which made it difficult for engineering students to obtain proper employment during the past summer vacation. News of this undoubtedly spreads around among prospective university applicants.

The same trend is evident when one looks at the estimated number of 1959 graduates. A slight decline is expected. If students presently in their final year complete their courses, 2,104 will graduate and enter the profession next spring. This follows an estimated figure of 2,130 for 1958. If the forecast proves accurate, it will mark the first time that the size of the graduating class has fallen off since the student veterans left the scene. As mentioned above, new facilities and the influence of oncoming classes should soon boost this total again.

On the brighter side of the picture this year, readers will notice the ever-growing number of universities and colleges listed. We now have 30 educational institutions in Canada where some kind of an engineering course is offered, and 15 of these now grant degrees. It is interesting to watch the continued rapid growth of engineering education in Western Canada. This year's survey has disclosed that 30 per cent of students now enrolled in engineering are taking their courses west of the Lakehead.

An examination of the results in the different faculties shows a steadily increasing interest in the study of engineering physics, as commented on last year. Total enrolment in this branch now stands at 727 which is an increase of 12½ per cent over 1957. The Sputnik age is certainly having its effect on young minds in their choice of studies. A close observation of the table of courses will show that aeronautical engineering has disappeared from the list. This has been a part of the training offered at the University of Toronto for many years. The explanation lies in the fact that these aeronautical students now take their instruction under the course in engineering physics, up to B.A.Sc. degree. Aeronautical engineering as such is now shown as a post-graduate course.

ASME-E.I.C. Conference on Engineering Education

"How Should Industry Aid Engineering Education?" This was the theme of the third biennial engineering education conference, sponsored jointly by the American Society of Mechanical Engineers and the Engineering Institute of Canada, held at the University of Michigan at Ann Arbor, October 15 and 16, 1958.

Attendance was by invitation, and invitations were sent to equal numbers of educators and industrialists. One hundred and seventeen delegates attended the conference, of which 33 came from Canada. Eleven Canadian universities were represented, from Halifax to Edmonton.

In order to provide the greatest possible freedom of expression and discussion, the presiding chairman, E. W. Allardt, vice-president, Region V, ASME, requested at the opening session that the conference be "off the record". The conference was divided into three sessions which took the form of panel presentations followed by general discussion. Dr. Harlan H. Hatcher, President, University of Michigan, welcomed the delegates at the opening luncheon.

The speaker at the dinner following the opening day's sessions was Dr. C. M. Anson, immediate past president of the Engineering Institute. He began his remarks by asking, "Should industry aid engineering education?" He said, "Industry needs engineers today; it will need them in greater numbers tomorrow. There lies the answer then to my first question. Industry not only should, it must aid engineering education." He went on to discuss the evolution of engineering education and pointed out some of the things he found deficient in the present system. He emphasized the importance of training in labour relations.

At the closing luncheon, Dr. K. F. Tupper, president of the Engineering Institute of Canada, related some of the things he had seen during a trip, just completed, to the Union of Soviet Socialist Republics. He described briefly the methods of engineering education in Russia and mentioned some of the construction projects he had seen during this short but crowded visit.

The first panel presentation was on the topic, "The Philosophy of Co-operation Between Industry and Higher Education". The moderator was Richard G. Folsom, president of Rensselaer Polytechnic Institute, who introduced the panelists. These were: Ira Needles, Chairman of the Board, B. F. Goodrich Rubber Co. of Canada; Raymond O. Darling, assistant to the director of educational relations, General Motors Corporation, Detroit, and Eugene H. Case, director of college and university relations, Deere & Co., Moline, Illinois.

Mr. Needles described the work he is now doing in developing engineering courses on a co-operative basis with industry at Waterloo College. He indicated several ways in which industry could aid education, including grants for specific activities, scholarships and gifts of equipment. Both Messrs. Darling and Case mentioned that competitors in industry had access to the same raw materials, to the same technology and to the same markets. The only difference lay in people and in the direction of their activities, hence the need and the obligation for industry to assist education. Money alone was not enough. The following guiding principles in developing programs of assistance were enumerated:

1. All programs of assistance to education should be evaluated in the light of demonstrated need on the part of the educators.
2. Avoid becoming involved in educational matters which are strictly the property of educators, such as the development of teaching methods.
3. All classroom aids should be field tested before being made available to educators and students.

The following ways of aiding education were also suggested by one of the panelists:

1. Through the printed and spoken word and day to day actions, place an emphasis on increasing the respect of the public for learning and the teaching profession.
2. Provide scholarships, not for the students but for the faculty.
3. Encourage the participation of industry's best people in the broad aspects of the educational process.
4. Increase the recognition that everyone and every corporation has a vital interest in the advancement of our educational system and the development of the individual.

The second panel session was on the topic, "Continuing Education by Industry in Industry". The moderator was R. D. Richmond, chief engineer of special weapons, Canadair Limited. The panelists were: H. L. Shepherd, in charge of salary administration and personnel development at Canadian Westinghouse, Hamilton; John Gammell, director, graduate training program, Allis-Chalmers, Milwaukee, and Dr. Alan W. Brown, former president of Hobart College.


From left to right, at left: Panel members: Ernest T. Stewart, J. Moreau Brown, G. Ross Lord, Pierre Gendron, Alan W. Brown, John Gammell, and H. L. Shepherd.

Below: With E. W. Allardt, left, panel members R. O. Darling, Ira Needles and E. H. Case, and Moderator Richard G. Folsom, right.


The following methods were among those described for continuing education in industry; private coaching on the skills of a job, technical conferences, manager training courses, pre-management courses, recruiting and induction procedures, job rotation and special skill courses. In concluding his remarks Mr. Shepherd said: "Perhaps the greatest education of all is the engineer's growing realization of his favoured position in society and a sense of obligation to contribute realistically and well".

Mr. Gammell reported on some of the courses operated by his company, including one involving a great deal of mathematical analysis, reserved for brilliant students who expect to go into research, design or development. He also mentioned special courses arranged from time to time to take care of particular needs, using where necessary local vocational schools to do the instructing.

Dr. Brown spoke of the following: in-service education and training versus sponsorship of outside study in local institutions; the upgrading of personnel, not merely in the useful and the applied but in terms of widening of horizons and the encouragement of imagination; the use of television, whether closed or open circuit, for educational and training purposes. He expanded his remarks concerning educational television, pointing out the advantages of this method of imparting instruction. Dr. Brown is president of the Metropolitain Educational Television Association, New York.

The final session dealt with "Support by Industry of Higher Education". The moderator was J. Moreau Brown, administrator of corporate support programs, General Electric, New York. The panelists were: Dr. Pierre Gendron, dean of the faculty of pure and applied science, University of Ottawa; Dr. G. Ross Lord, head of the department of mechanical engineering, University of Toronto.

In his remarks, Dr. Gendron suggested the following ways for industry to assist education: contribution to building funds, unrestricted support for operations, undergraduate scholarship programs, research grants, consulting fees for certain staff members. He based his recommendations on the concept that "Industry has always been very farsighted in providing for future raw materials and should also be farsighted in the supply of technical personnel to work these raw materials."

Dr. Lord spoke of graduate study and research, dealing more particularly with Canadian problems. He discussed the value of graduate training and the national value of research. He suggested larger fellowships should be granted, with matching amounts to the university. He also suggested that gifts to universities should have fewer strings, with more trust in the university to use the money wisely and well.

E. T. Stewart explored the problem of selectivity in corporate giving. He said there were nearly 2,000 recognized institutions of higher learning and that it was necessary for corporations to limit their programs. He also asked if industry should limit its support to higher education. In concluding his presentation, he said: "Because of the problems of selectivity, corporations have done much experimenting in setting up their aid-to-education programs. On the whole this has been a healthy development. But time will bring more careful evaluations of existing programs to insure their worth."

The discussions which followed the panel presentations were lively and the chairman found it difficult to close off discussion. This was strong evidence indeed of the interest in engineering education on the part of educators and industrialists. Even though no resolutions were passed, the delegates left the conference with a better understanding of the problems of industry's assistance to education, and with new ideas arising from the experience of others.

The Annual Index is in this issue.

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THE ENGINEERING JOURNAL

REGISTRATION IN ENGINEERING AT CANADIAN UNIVERSITIES

University	Year	General Course	Agricultural Engineering	Petroleum Engineering	Chemical Engineering	Civil Engineering	Electrical Engineering	Engineering and Business Administration	Mechanical and Electrical Engineering	Forest Engineering	Geology and Mineralogy Engineering	Mechanical Engineering	Metallurgical Engineering	Mining Engineering	Engineering Physics	Total
Memorial	1st	64	....	....	....	....	....	....	....	....	....	....	....	....	....	64
	2nd	38	....	....	....	....	....	....	....	....	....	....	....	....	....	38
	3rd	36	....	....	....	....	....	....	....	....	....	....	....	....	....	36
Total....		138	....	....	....	....	....	....	....	....	....	....	....	....	....	138
Dalhousie	1st	69	....	....	....	....	....	....	....	....	....	....	....	....	9	78
	2nd	71	....	....	....	....	....	....	....	....	....	....	....	....	5	76
	3rd	25	....	....	....	....	....	....	....	....	....	....	....	....	1	26
	4th	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1
	5th	....	....	....	....	....	....	....	....	....	....	....	....	....	3	3
Total....		165	....	....	....	....	....	....	....	....	....	....	....	....	19	184
St. Mary's	1st	51	....	....	....	....	....	....	....	....	....	....	....	....	....	51
	2nd	23	....	....	....	....	....	....	....	....	....	....	....	....	....	23
	3rd	21	....	....	....	....	....	....	....	....	....	....	....	....	....	21
Total....		95	....	....	....	....	....	....	....	....	....	....	....	....	....	95
St. Francis Xavier	1st	112	....	....	....	....	....	....	....	....	....	....	....	....	....	112
	2nd	85	....	....	....	....	....	....	....	....	....	....	....	....	....	85
	3rd	75	....	....	....	....	....	....	....	....	....	....	....	....	....	75
Total....		272	....	....	....	....	....	....	....	....	....	....	....	....	....	272
N.S. Technical College	4th	....	....	....	18	55	58	....	....	....	....	28	4	4	....	167
	5th	....	....	....	9	38	37	....	....	....	....	24	1	6	....	115
Total....	....	....	....	....	27	93	95	....	....	....	....	52	5	10	....	282
Acadia	1st	46	....	....	....	....	....	....	....	....	....	....	....	....	....	46
	2nd	43	....	....	....	....	....	....	....	....	....	....	....	....	....	43
	3rd	50	....	....	....	....	....	....	....	....	....	....	....	....	....	50
Total...	....	139	....	....	....	....	....	....	....	....	....	....	....	....	....	139
Mount Allison	1st	80	....	....	....	....	....	....	....	....	....	....	....	....	....	80
	2nd	74	....	....	....	....	....	....	....	....	....	....	....	....	....	74
	3rd	67	....	....	....	....	....	....	....	....	....	....	....	....	....	67
Total....	....	221	....	....	....	....	....	....	....	....	....	....	....	....	....	221
New Brunswick	1st	....	....	....	15	58	47	....	....	....	....	35	....	2	....	157
	2nd	....	....	....	17	76	46	....	....	....	....	32	....	2	....	173
	3rd	....	....	....	7	64	48	....	....	....	....	20	....	1	....	140
	4th	....	....	....	....	55	28	....	....	....	....	31	....	....	....	114
	5th	....	....	....	....	54	13	....	....	....	....	18	....	....	....	85
Total....	....	....	....	....	39	307	182	....	....	....	....	136	....	5	....	669
Laval	1st	160	....	....	....	....	....	....	....	....	....	....	....	....	....	160
	2nd	233	....	....	....	....	....	....	....	....	....	....	....	....	....	233
	3rd	....	....	....	5	56	38	....	....	....	5	23	10	7	7	151
	4th	....	....	....	13	44	14	....	....	....	1	15	4	....	4	95
	5th	....	....	....	6	24	15	....	....	....	3	15	3	8	10	84
Total....	....	393	....	....	24	124	67	....	....	....	9	53	17	15	21	723
Ecole Polytechnique	1st	267	....	....	....	....	....	....	....	....	....	....	....	....	....	267
	2nd	327	....	....	....	....	....	....	....	....	....	....	....	....	....	327
	3rd	213	....	....	....	....	....	....	....	....	....	....	....	....	....	213
	4th	....	....	....	14	69	38	....	....	....	1	33	7	8	9	179
	5th	....	....	....	5	46	....	....	64	....	2	....	5	2	....	124
Total....	....	807	....	....	19	115	38	....	64	....	3	33	12	10	9	1,110

REGISTRATION IN ENGINEERING AT CANADIAN UNIVERSITIES

University	Year	General Course	Agricultural Engineering	Petroleum Engineering	Chemical Engineering	Civil Engineering	Electrical Engineering	Engineering and Business Administration	Mechanical and Electrical Engineering	Forest Engineering	Geology and Mineralogy Engineering	Mechanical Engineering	Metallurgical Engineering	Mining Engineering	Engineering Physics	Total
McGill	1st	260	....	....	....	....	....	....	....	....	....	....	....	....	....	260
	2nd	363	....	....	....	....	....	....	....	....	....	....	....	....	....	363
	3rd	....	....	....	34	56	82	....	....	....	....	60	14	8	26	280
	4th	....	....	....	26	93	60	....	....	....	....	66	7	5	21	278
	5th	....	....	....	36	66	67	....	....	....	....	49	7	3	10	238
Total....	....	623	....	....	96	215	209	....	....	....	....	175	28	16	57	1,419
Sir George Williams College	1st	85	....	....	....	....	....	....	....	....	....	....	....	....	....	85
	2nd	18	....	....	....	....	....	....	....	....	....	....	....	....	....	18
Total....	....	103	....	....	....	....	....	....	....	....	....	....	....	....	....	103
Sherbrooke	1st	65	....	....	....	....	....	....	....	....	....	....	....	....	....	65
	2nd	70	....	....	....	....	....	....	....	....	....	....	....	....	....	70
	3rd	41	....	....	....	....	....	....	....	....	....	....	....	....	....	41
	4th	....	....	....	....	15	8	....	....	....	....	2	....	....	....	25
	5th	....	....	....	....	12	6	....	....	....	....	4	....	....	....	22
Total....	....	176	....	....	....	27	14	....	....	....	....	6	....	....	....	223
Ottawa	1st	86	....	....	....	....	....	....	....	....	....	....	....	....	....	86
	2nd	72	....	....	....	....	....	....	....	....	....	....	....	....	....	72
	3rd	....	....	....	12	10	16	....	....	....	2	8	....	....	....	48
	4th	....	....	....	7	....	5	....	....	....	....	....	....	....	....	12
	5th	....	....	....	5	....	6	....	....	....	....	....	....	....	....	11
Total....	....	158	....	....	24	10	27	....	....	....	2	8	....	....	....	229
Carleton	1st	44	....	....	....	....	....	....	....	....	....	....	....	....	....	44
	2nd	24	....	....	....	....	....	....	....	....	....	....	....	....	....	24
Total....	....	68	....	....	....	....	....	....	....	....	....	....	....	....	....	68
Queen's	1st	312	....	....	....	....	....	....	....	....	....	....	....	....	....	312
	2nd	....	....	....	57	42	36	....	....	....	18	49	9	14	29	254
	3rd	....	....	....	38	33	49	....	....	....	13	47	13	8	14	215
	4th	....	....	....	48	42	42	....	....	....	10	40	6	11	20	219
Total....	....	312	....	....	143	117	127	....	....	....	41	136	28	33	63	1,000
Toronto*	1st	....	....	....	75	82	87	33	....	....	15	71	11	11	153	538
	2nd	....	....	....	63	73	82	39	....	....	13	94	18	17	104	503
	3rd	....	....	....	48	92	100	35	....	....	25	68	11	21	80	480
	4th	....	....	....	62	88	67	41	....	....	12	104	6	21	63	464
Total....	....	....	....	....	248	335	336	148	....	....	65	337	46	70	400	1,985
McMaster	1st	50	....	....	....	....	....	....	....	....	....	....	....	....	....	50
	2nd	....	....	....	9	....	9	....	....	....	....	9	....	....	15	42
Total....	....	50	....	....	9	....	9	....	....	....	....	9	....	....	15	92
Ontario Agricultural College**	3rd	....	....	....	....	5	....	....	....	....	....	14	....	....	....	19
	4th	....	....	....	....	8	....	....	....	....	....	12	....	....	....	20
Total....	....	....	....	....	....	13	....	....	....	....	....	26	....	....	....	39
Waterloo*** College	1st	191	....	....	....	....	....	....	....	....	....	....	....	....	....	191
	2nd	263	....	....	....	....	....	....	....	....	....	....	....	....	....	263
Total....	....	454	....	....	....	....	....	....	....	....	....	....	....	....	....	454

*In previous years some students attending University of Toronto have been shown in a course of Aeronautical Engineering. No figure is given for this year and the explanation obtained from the University Calendar 1958-59 is that students in this course up to the level of B.A.Sc. degree are registered in the course in Engineering Physics. Aeronautical Engineering as such is now shown as a course in the School of Graduate Studies.

** Students in Agricultural Engineering who will proceed to their final year in Mechanical or Civil Engineering at the University of Toronto on completion of their studies at Guelph.

***Of these 263 students 45 are expected to enter 3rd year in January 1959 and 27 more will enter 3rd year in April 1959. This is because course intakes at Waterloo are on the "quarter system".

REGISTRATION IN ENGINEERING AT CANADIAN UNIVERSITIES

University	Year	General Course	Agricultural Engineering	Petroleum Engineering	Chemical Engineering	Civil Engineering	Electrical Engineering	Engineering and Business Administration	Mechanical and Electrical Engineering	Forest Engineering	Geology and Mineralogy Engineering	Mechanical Engineering	Metallurgical Engineering	Mining Engineering	Engineering Physics	Total
Western Ontario	1st	79	....	....	....	....	....	....	....	....	....	....	....	....	....	79
	2nd	45	....	....	....	....	....	....	....	....	....	....	....	....	....	45
	3rd	....	....	....	2	7	11	....	....	....	....	5	....	....	....	25
	4th	....	....	....	....	4	2	....	....	....	....	4	....	....	....	10
Total....	....	124	....	....	2	11	13	....	....	....	....	9	....	....	....	159
Assumption	1st	44	....	....	....	....	....	....	....	....	....	....	....	....	....	44
	2nd	....	....	....	8	12	11	....	....	....	....	5	....	....	....	36
Total....	....	44	....	....	8	12	11	....	....	....	....	5	....	....	....	80
Sudbury	1st	28	....	....	....	....	....	....	....	....	....	....	....	....	....	28
Total....	....	28	....	....	....	....	....	....	....	....	....	....	....	....	....	28
Manitoba	1st	312	....	....	....	....	....	....	....	....	....	....	....	....	....	312
	2nd	222	....	....	....	....	....	....	....	....	3	....	....	....	9	234
	3rd	....	....	....	....	56	37	....	....	....	2	46	....	....	4	145
	4th	....	....	....	....	49	43	....	....	....	8	49	....	....	5	154
Total....	....	534	....	....	....	105	80	....	....	....	13	95	....	....	18	845
Saskatchewan	1st	367	....	....	....	....	....	....	....	....	....	....	....	....	....	367
	2nd	275	....	....	20	....	....	....	....	....	....	....	....	....	....	295
	3rd	....	8	....	26	80	42	....	....	....	19	49	....	....	10	234
	4th	....	7	4	11	59	18	....	....	....	7	48	....	....	19	173
Total....	....	642	15	4	57	139	60	....	....	....	26	97	....	....	29	1,069
Alberta	1st	455	....	....	....	....	....	....	....	....	....	....	....	....	....	455
	2nd	....	....	25	62	118	102	....	....	....	....	36	5	9	2	359
	3rd	....	....	21	51	75	60	....	....	....	....	19	2	4	13	245
	4th	....	....	23	38	59	35	....	....	....	....	....	7	7	6	175
Total....	....	455	....	69	151	252	197	....	....	....	....	55	14	20	21	1,234
British Columbia	1st	371	....	....	....	....	....	....	....	1	....	....	....	....	....	372
	2nd	265	....	....	....	....	....	....	....	....	....	....	....	....	....	265
	3rd	....	....	....	18	38	57	....	....	1	7	37	12	8	29	207
	4th	....	....	....	16	41	55	....	....	1	12	53	16	5	28	227
Total....	....	636	....	....	34	79	112	....	....	3	19	90	28	13	57	1,071
Canadian Services Colleges																
Royal Military College (Kingston)	1st	68	....	....	....	....	....	....	....	....	....	....	....	....	....	68
	2nd	42	....	....	....	....	....	....	....	....	....	....	....	....	....	42
	3rd	....	....	....	20	32	33	....	....	....	15	....	....	....	15	115
	4th	....	....	....	12	23	27	....	....	....	24	....	....	....	3	89
Total....	....	110	....	....	32	55	60	....	....	....	39	....	....	....	18	314
Royal Roads	1st	89	....	....	....	....	....	....	....	....	....	....	....	....	....	89
	2nd	53	....	....	....	....	....	....	....	....	....	....	....	....	....	53
Total....	....	142	....	....	....	....	....	....	....	....	....	....	....	....	....	142
Collège Militaire Royal de St.-Jean	1st	93	....	....	....	....	....	....	....	....	....	....	....	....	....	93
	2nd	72	....	....	....	....	....	....	....	....	....	....	....	....	....	72
Total....	....	165	....	....	....	....	....	....	....	....	....	....	....	....	....	165
Grand Total	....	7,054	15	73	913	2,009	1,637	148	64	3	217	1,322	178	192	727	14,552
Prospective 1959 Graduates	....	....	7	27	236	582	406	41	64	1	54	408	51	63	164	2,104

E.C.P.D. 26th Annual Banquet. The Engineers' Council for Professional Development held its 26th annual meeting at St. Louis, Missouri, on October 8 and 9. The Engineering Institute's representative on the executive committee is W. S. Wilson, of Toronto, seated third from the right at the head table. A report of the meeting appeared in the November issue.

Elections and Transfers

A number of applications were presented for consideration and on the recommendation of the Admissions Committee, the following elections and transfers were effected:

Members: A. G. Antonopoulos, Montreal; S. I. Csibor, Montreal; H. C. Dawson, Toronto; H. J. DeSmet, Montreal; R. G. Frederick, Port Hope; H. B. Fuller, Montreal; R. C. Gunn, Toronto; R. F. Harris, London; R. A. C. Hausser, Montreal; C. T. Heeney, Ottawa; A. J. Kruysse, Montreal; M. P. Lawlor, Vancouver; W. F. McGarry, Ottawa; R. F. Marshall, Don Mills; A. G. Moffatt, Winnipeg; W. F. Moore, Arvida; J. G. Sutherland, Hamilton; D. S. Watson, Winnipeg.

Juniors: C. D. Couzens, Toronto; G. Douglas, Montreal; K. L. Smith, Deep River; N. H. Tawfik, Shawinigan.

Affiliate: J. R. Gordon, New York.

Junior to Member: H. A. Benson, Calgary; W. P. Harris, Montreal; G. C. Stewart, Victoria; R. L. Walker, Ceylon.

STUDENTS ADMITTED

Nova Scotia Technical College: P. E. Bowser, S. A. Butcher, R. O. Butler, D. J. Cameron, P. A. Clarke, H. A. Coneen, R. C. Connors, B. K. Conrad, J. R. Dick, J. H. Farrell, R. J. Fougere, D. E. Fraser, R. H. Gillis, L. D. Hicks, G. H. Keenan, D. A. Kilgour, J. R. Landsky, F. C. S. Lee, W. R. Legge,

A. H. K. Ma, J. D. MacDonald, D. J. MacDougall, D. Z. MacInnis, J. H. MacLean, J. M. MacLean, C. J. MacLellan, J. M. P. McCaffrey, C. W. McGillicuddy, J. E. J. McNeil, R. H. Montgomery, M. L. Nickerson, R. E. Nickerson, W. G. G. Nooyen, R. T. O'Dell, J. F. O'Reilly, R. E. Parker, R. H. Poitras, H. A. Sealy, R. P. Shaffelburg, S. J. Smart, R. C. S. Smith, D. J. Sperry, W. J. Stewart, J. S. Sullivan, J. W. Taylor, C. G. Wadden.

University of New Brunswick: F. J. Aucoin, D. Beardsley, W. F. Blair, R. M. Bouchard, J. P. Coombes, W. W. Colpitts, S. E. Dick, J. B. Di Diodato, S. C. Douglass, D. M. Fellows, J. B. Forrest, E. E. Gillespie, J. D. P. Graham, D. G. Hayward, D. E. Hersey, H. W. Hoyt, F. L. Le Fort, J. G. MacDonald, J. F. MacElmon, R. J. Morden, C. R. Reynolds, H. A. Savoy, F. H. Schatz, E. R. Smith, N. H. Walker, J. H. Walsh.

University of Alberta: T. W. Bahniuk, R. L. Coulman, W. A. Dalgliesh, E. Drucker, G. W. Elkington, C. R. G. Halls, C. D. D. Howard, H. Klukas, A. N. Koskowich, C. C. Louis, R. F. Lukey, R. A. MacKett, W. G. Magee, B. Mah, R. F. C. Marriott, J. R. Maze, E. M. Morrison, D. G. Pennell, K. Shimizu, V. A. Sowa, R. S. Thomson.

University of Toronto: J. L. Drolet, C. S. Halliday, R. I. Harvie, W. A. Heard, J. W. Hicks, R. C. Landsborough, M. C. Mapp, A. Mottershead, M. J. Seliga, W. B. West.

Sir George Williams College: L. Geller, N. W. Harvison, M. Konecny, J. G. Meek, J. G. Mezofenyi, N. G. Novak.

Dalhousie University: E. W. Jones, J. A. MacKenzie, R. S. Smith, R. C. Trider, K. P. Wong.

St. Dunstan's University: E. J. Arsenault, J. M. Kennedy, W. E. Power, L. J. Praught.

Royal Military College: J. A. F. L. Gagnon, W. H. Rozel.

Laval University: M. Tremblay.

University of Sherbrooke: R. G. Boily.

University of Toronto: J. R. Britton, W. K. Wells.

Applications through Associations

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

Alberta

Members: H. D. Hamer-Hunt, P. Teensma.

Manitoba

Members: W. E. A. Brandford, H. O. Coish.

Nova Scotia

Members: G. A. Collins, H. H. Jones, J. C. Marsh, L. Meszaros, A. E. Steeves, G. S. Trivett, J. H. White; **Junior to Member:** A. T. Ball, G. R. Pond, J. H. Merritt.

DID YOU KNOW THAT

There are now three publications of The Engineering Institute: *The Engineering Journal*, issued monthly; *Transactions* of The Engineering Institute of Canada, issued quarterly; and *Engineering Careers in Canada*, issued yearly.

1959

Meetings of

THE ENGINEERING INSTITUTE OF CANADA

Annual General and Professional Meeting
June 8, 9, 10, 1959
Royal York Hotel,
Toronto, Ont.

Regional Meetings
Southern Ontario Regional Conference
Hamilton, Ont.
March 14, 1959

Western Regional Technical Conference
Banff, Alberta,
October 2, 3, 1959

Ottawa Regional Meeting
Celebrating the 50th Anniversary of the Ottawa Branch
Ottawa, Ont.,
October 18-19, 1959.

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OBITUARIES

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Fraser Sanderson Keith, M.E.I.C., retired manager of the Shawinigan Water and Power Company's Department of Development and general secretary of the Engineering Institute from 1917 to 1925, died on October 28, 1958 at Smith's Falls, Ont.

Born at Smith's Falls, Ontario, on June 8th, 1878, he attended school there, after which he went to McGill University and graduated with a B.Sc. degree in electrical engineering in 1903.

After graduation he joined the staff of McGill University for a one-year term as senior demonstrator in the electrical engineering department. Subsequently he gained a very extensive experience in editorial work with a number of well-known Canadian technical publications, *Canadian Machinery*, 1904-05-06, *Canadian Manufacturer*, 1907, *Construction*, 1917, occupying such positions as managing editor and editor.

In 1908 he went to Vancouver, and for the following six years was engaged in concrete construction and the manufacture and sale of concrete materials. Returning to Eastern Canada early in 1915, he became manager of technical publications, eastern region, with the MacLean Publishing Company, during which time he wrote a series of articles on the adoption of ingenious methods by Canadian manufacturers, in the manufacture of ammunitions, which articles were afterwards published by the Australian Government as a guide to similar production on that continent.

His association with The Engineering Institute of Canada began in 1917, on his appointment as general secretary. The Engineering Journal was designed and inaugurated in 1918 by Mr. Keith as manager and editor.

Helped by the initiative and ability of Mr. Keith, the Institute made rapid and steady progress during the period. The Institute increased its branches across Canada from nine to twenty-four and its membership from 3,100 to 5,400.

He was official Canadian delegate to the first World Power Conference in London in 1924.

Mr. Keith resigned as general secretary in 1925 to assume the post of manager of the Department of Development, Industrial and Public Relations with the Shawinigan Water and Power Company, Montreal. He retired in 1944.

Throughout his life he was active in the McGill Graduates Society. He held various offices in the organization leading to his election as president, 1943-1944. His election as a graduates' representative on the board of governors of McGill, for a three-year term, was announced in 1945. He was granted a life-membership in the Society in 1953.

Mr. Keith joined the Institute as a Student Member in 1902, became Associate Member in 1909, and a Member in 1921. In 1947 he attained Life Membership in the Institute.

D. W. Hays, M.E.I.C., a noted engineer, pioneer and authority on Western Canadian irrigation development, died on September 12, 1958, at Medicine Hat, Alta. Mr. Hays had been living in retirement in the Southern Alberta community since 1950.

David Walker Hays, for whom an Alberta community in the Vauxhall district of the province was named, in honour of his accomplishments in irrigation, was born at Bridgeport, Calif., on March 24, 1878. He attended the MacKay School of Mines, at Reno, Nevada, and received a Bachelor of Science degree at 1900. In his early graduate career Mr. Hays worked briefly with the Department of Highways, State of California, and with a U.S. geological survey as a field assistant. With the United States Reclamation Service, he was shortly thereafter engaged in the construction of irrigation works in Nevada and California, on the general investigation of five irrigation projects in those states.

On the instigation of a group of British investors he moved to Canada in 1912 to study the irrigation problems in this once-dry corner of Alberta. The firm was called the Southern Alberta Land Company.

Mr. Hays was a prominent figure in the early-day history of the old Southern Alberta Land Company which became the Canada Land and Irrigation Company. For thirty-nine years he directed the affairs of the company from his Medicine Hat headquarters.

Mr. Hays was elevated to a higher post when the Southern Alberta Land Company fused its interests with those of the Canadian Wheatlands and the Alberta Land Company to form the Canada Land Irrigation Company, with control of 530,000 acres. In 1925 he was named general manager. A quarter of a century later the Canada Land Irrigation company was sold to the Dominion, becoming the Bow River Development. Mr. Hays retired at that time, having lived to see the irrigation of 40,000 acres of land.

During his long years of public service Mr. Hays was instrumental in the establishment of the Ronalane Experimental Station brought into being by the Canada Land.

He was also called into service as a consultant on the Royal Commission on the proposed South Saskatchewan River dam, and on the Bow River development.

Mr. Hays joined the E.I.C. as a Member in 1918. He was named to Life Membership in 1949.

S. C. Montgomery, M.E.I.C., vice-president of the Engineering Institute, representing the Western Provinces for a two-year term, 1957-1959, died at Calgary on October 19. Mr. Montgomery was a maintenance engineer with the Consolidated Mining and Smelting Company, smelting and refining division, Trail, B.C.

Samuel Clifford Montgomery was born in Winnipeg on July 24, 1894, and had his schooling there. He graduated from McGill University with a B.Sc. degree in mechanical engineering in 1915.

Enlisting in the Canadian Field Artillery almost immediately, he served with the First Division in France, the Fifth Brigade, Second Division, and won the Military Cross.

After a refresher course at the Royal Technical College, Glasgow, he returned to Canada late in 1919.

Re-established in this country he began the next phase of his engineering career as a designing draughtsman with the Whalen Pulp and Paper Company in British Columbia, worked in the logging industry on Vacouver Island and in 1925 became assistant superintendent of construction and maintenance.

In 1929 he joined the Consolidated Mining and Smelting Company at Trail as a designing draughtsman, later as an assistant construction engineer on the Tadanac plants. His last professional responsibility as maintenance engineer, smelting and refining department was announced in 1948.

Mr. Montgomery joined the Engineering Institute as a Student Member in 1911, transferred to Junior status in 1920, Associate in 1929, Member in 1940. A charter member of the Kootenay Branch he was its first chairman and councillor.

F. S. Keith, M.E.I.C.

D. W. Hays, M.E.I.C.

S. C. Montgomery, M.E.I.C.

NEWS OF THE

Associations and Corporation

Information received through co-operation of the provincial organizations.

ONTARIO

A multi-purpose education foundation has been established by the 17,000-member Association of Professional Engineers of Ontario. Known as the Ontario Professional Engineers' Foundation for Education, one of its basic purposes will be to provide financial assistance to members of the teaching profession and persons proposing to become teachers who will specialize in mathematics and science subjects.

C. T. Carson, president of the A.P.-E.O. points out that "there is a dangerous shortage of qualified maths and science teachers in this country at present". He adds that the Association hopes the establishment of such a foundation will encourage an increasing interest in these subjects by teachers. The foundation will also promote and assist the post-graduate training and education of professional engineers to enable them to achieve higher professional qualifications. The foundation will accept contributions, gifts, bequests and legacies, with gifts being deductible for income tax purposes. The foundation was approved by the Association's Executive Council as a means of augmenting the present scholarship program undertaken by the engineering body The existing program includes a $500 scholarship given in alternate years annually to the University of Toronto and Queen's University for the student entering an engineering course at either university with the highest academic standing in grade XIII. Additional annual scholarships each valued at $250.00 are awarded at both universities in the first. second and third years.

The newly-established education foundation will be administered by the Association's permanent staff which is headed by Col. T. M. Medland, executive director.

BRITISH COLUMBIA

(Taken from the B.C. Professional Engineer, October issue, by A. H. Ashworth, P.Eng., member of the editorial board.)

Unfair to Ourselves

No self respecting Professional Engineer would ever want to be accused of being a square peg in a round hole amongst his fellow members, and yet this risk is inadvertently run at times.

When the day arrives on which an engineer retires from active service, how gratifying it would be for him to be able to look back upon his term of office with an easy conscience and a realization that he took all the opportunities which arose to help make the lot of his colleagues a happier one.

Can every engineer honestly say to himself that he has taken each opportunity to give his fellows a helping and understanding hand? It is easy to turn a blind eye, especially if the other fellow is a new or younger person.

Medicine, not engineering, is the one profession that labours incessantly to destroy the reason for its own existence. In comparing the Medical Profession, however, we see amongst its members an admirable spirit of friendly co-operation and mutual assistance that sets them above other professions in this respect.

That luck represents a real factor in human experience is evident to us all, and he who does not expect ill-fortune as one of the ingredients of life is trying to live in a fantasy world of his own. However, bad luck can come with unnecessarily crippling force against those engineers who have to battle constantly with not only the occupational hazards of the profession but also indifference from their colleagues who may be in more secure positions.

You can't fool all the people all the time, but it isn't necessary. A majority of the people will do: and most people think that engineers all pull together and are like a great big happy family. Much patient self-inspection is indicated, for ignorance is a voluntary condition.

Each engineer, as he works away in his career, could do no harm to remember to be helpful to his fellow engineers on his way up, if only because he would meet them all again on the way down.

It is easy to look down on others; to look down on ourselves is the difficulty. Let us all, in this great profession, pause a moment to see if we are as Shakespeare describes: "As sick that surfeit with too much, as they that starve with nothing."

CANADIAN COUNCIL

(Taken from the B.C. Professional Engineer, October issue)

The Canadian Council was recently requested to express an opinion on the present employment situation in the engineering profession. In view of the absence of complete and accurate statistics it was felt that the best source of information would be the secretariats of the various provincial associations. The information obtained is summarized below.

In the less industrialized provinces, the situation appears to be somewhat balanced. No engineers are known to be unemployed and known vacancies for engineers are few or non-existent.

In the more industrialized provinces there appears to be an over-supply of engineers, the extent of which is extremely difficult to evaluate.

Although the number of known unemployed engineers appears to be relatively low, most large employers of engineers are doing their best to find employment for their engineering staff at the expense of technicians and others in order to have a trained engineering staff available when needed in the future. Some of these admit that they could function with 10 per cent less than they now have.

In addition, a large number of professional engineers are still being employed for work that could be adequately carried out by sub-professionals or technicians and are unable to find more suitable employment.

1958 graduates received mostly only one offer while several were still unemployed two months after graduation.

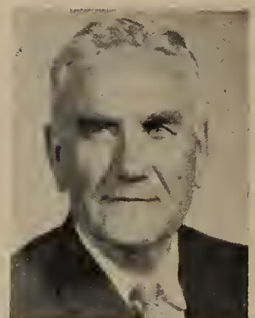
From the above, we can conclude that there is presently in Canada an over-supply of engineers which exceeds substantially the actual number of engineers known to be unemployed.

From present enrolment, it can be fairly accurately estimated that total graduations in engineering from our universities in the next four years will be 10,500 and, in view of the present over-supply, it can be safely predicted that Canada will not be faced with a critical shortage of engineers during that period even assuming a substantial improvement in economic activity.

Personals

News of the Personal Activities of Members of the Institute


L. B. Stacey, M.E.I.C.


D. A. McCuaig, M.E.I.C.


R. C. Short, M.E.I.C.

W. A. Dawson, M.E.I.C. (B. Sc., Mech., Queen's 1923), has been appointed assistant sales manager, Brown Boggs Foundry and Machine Co Ltd., Hamilton, Ont. Associated with two of Canada's leading machine tool distributors in the posts of sales engineer and branch manager since 1946, Mr. Dawson has 20 years of experience in industrial engineering and manufacturing. He is a past chairman, Hamilton Branch, E.I.C., 1953.

J. G. Little, M.E.I.C., (B.A.Sc., chem., Toronto, 1928), has recently been appointed general manager of the wire and cable division of the Northern Electric Company Limited, Montreal.

Mr. Little who has devoted his entire career to the Company, held various positions in the firm, including those of works manager, electronics division, in 1946, works manager, wire and cable division, 1950, and assistant manager of the division, 1956.

Major E. A. Marshall, M.E.I.C., M.B.E., C.D., (B.Sc., civil, Manitoba, 1936), Canadian Army retired, has accepted a position as vice-president in charge of the military pyrotechnics division of the T.W. Hand Fireworks Company Limited, with headquarters in Ottawa. Mr. Marshall formerly headed the ammunition design and development section, Canadian Army. He represented Canada at many meetings of NATO groups of experts on ammunition.

Gordon R. Henderson, M.E.I.C., (B.Sc., civil, Queen's, 1925), has been elected president and director of the Catalytic Construction of Canada Limited, at the Sarnia, Ont., headquarters of the organization. Mr. Henderson is the person originally responsible for the formation of Catalytic in Canada. He assumed the general managership of Catalytic's Canadian activities in 1951. He was appointed general manager of the Sun Oil Company Limited refinery, Sarnia, in 1953, in connection with the Catalytic organization and has held the post until the present time.

R. C. Short, M.E.I.C., (B.A.Sc., elec., Toronto, 1949), has been appointed Ontario district manager for Ferranti-Packard Electric Limited. His previous appointment was that of district manager for the Quebec division of Packard Electric Company Limited, Montreal.

D. A. McCuaig, M.E.I.C., (B.Sc., elec., Manitoba, 1923), has been named Manitoba district manager for Ferranti-Packard Limited. At an earlier date he was district manager with Ferranti, for Ontario, with headquarters in Toronto, and for Western Canada, at Winnipeg.

L. B. Stacey, M.E.I.C., (B.A.Sc., British Columbia, 1924), district manager for the Packard Electric Company Limited, Vancouver, has been named district manager, B.C., for Ferranti-Packard Limited. Mr. Stacey joined Packard Electric Company Limited in 1944.

Richard Scott, M.E.I.C., (B.A.Sc., elec., Toronto, 1941; M.Sc., Massachusetts Institute of Technology, 1948), is a senior associate of the management consulting firm of J. Edgar Dion and Company Limited, Montreal. Mr. Scott was for many years a member of the faculty of applied science and engineering, University of Toronto. Mr. Scott most recently was associated with Canadian Aviation Electronics Limited as manager, manufacturing division.

J. Homer Johnston, M.E.I.C., (B.Sc., Queen's 1910), since 1951 chief maintenance engineer for the Province of Alberta has retired. Mr. Johnston devoted his entire career to Alberta and the northern area of the country. On graduation he was appointed assistant Dominion Land Surveyor, for the Federal Government. He surveyed the Coalspur area west of Edmonton, and was, the following year, commissioned as a Dominion Land Surveyor, carrying out many surveys in the Peace River and Grande Prairie areas. In 1921 he headed an exploratory canal trip of mapping and surveying from Peace River, Alta., to Great Slave Lake, N.Y.T. He was dis-


W. A. Dawson, M.E.I.C.


R. Scott, M.E.I.C.


Major E. A. Marshall, M.E.I.C.


J. G. Little, M.E.I.C.


J. H. Johnston, M.E.I.C.

trict engineer at Peace River from 1925 to 1948, and then assistant chief maintenance engineer, at headquarters, Edmonton, until the time of his most recent posting.

Wm. A. Devereaux, M.E.I.C., (B.A.Sc., mech., Toronto, 1937), formerly district manager of the Halifax office of Bailey Meter Company Limited, in charge of sales and service work in the Atlantic provinces, is now district manager of the Winnipeg branch of the company. He is in charge of similar work for Saskatchewan, Manitoba and Northwestern Ontario.

D. L. B. Hamlin, M.E.I.C., (B.A.Sc., civil, Toronto, 1943), has been appointed to take charge of structural engineering for the firm of Margison and Keith, engineers and architects, Toronto. Mr. Hamlin was an associate of the firm of A. D. Margison and Associates, recently reorganized.

Colonel J. S. Beeman, M.E.I.C., (B.A.Sc., chem., British Columbia, 1935), has been promoted to military observer with the United Nations Military Observer Group in India and Pakistan. Col. Beeman was formerly assistant quartermaster general,

G. M. Beaumont, M.E.I.C.

T. H. Newton, M.E.I.C.

Lt.-Col. A. Mendelsohn, M.E.I.C.

at Canadian Army, western command headquarters.

Group Captain Chas. W. Crossland, M.E.I.C., (B.Sc., McGill, 1931; M.Sc., aeronautical, M.I.T., 1932), former assistant for standardization, at R.C.A.F. headquarters, Ottawa, has been named visiting assistant professor at McGill University.

Lieutenant Colonel A. Mendelsohn, M.E.I.C., (B.Eng., mech., McGill, 1939), was former commander of the R.C.E.-M.E., First Canadian Infantry Division. A new posting has named him assistant director of electrical and mechanical engineering at Canadian Army headquarters, Ottawa.

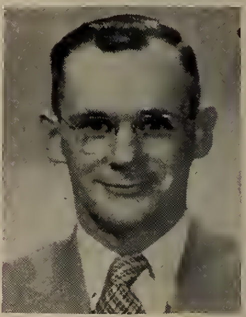
T. H. Newton, M.E.I.C., (B.Sc., civil, Alberta, 1948), of Edmonton holds the office of chairman of the E.I.C. Branch in that city. Mr. Newton has followed his engineering career with Main, Rensaa and Minsos, Edmonton, as resident engineer and as Canadian representative with the Lee Oil and Natural Gas Company, Edmonton.

C. W. Henry, M.E.I.C., (B.Sc., elec., New Brunswick, 1946), is chairman of the Newfoundland Branch of the E.I.C. for 1958. Mr. Henry is professionally associated with the Newfoundland Light and Power Company Limited at St. John's, Nfld., as a transmission and substation engineer. Early in his career he went to Maracaibo, Venezuela as assistant distribution engineer with C. A. Energia Electrica de Venezuela.

G. M. Beaumont, M.E.I.C., (B.Sc., mech., Sask., 1949), has left the consulting engineering firm of Underwood, McLellan and Associates Limited, Saskatoon and has returned to the University of Saskatchewan to study law.

Mr. Beaumont has had engineering experience as chief engineer in charge of water and sewage treatment, plant design, at a number of Western Canadian points.

Roy C. Leslie, M.E.I.C., (B.A.Sc., M.Sc., civil, Toronto 1923), of the Dominion Steel and Coal Corporation Limited, Canadian Bridge division, Toronto, has been named to a new post. Formerly district contracting engineer, the appointment is that of assistant sales manager in



C. W. Henry, M.E.I.C.

the same division of the company. He is a past secretary and chairman of the Border Cities Branch.

Professor P. S. Mani Sundaram, M.E.I.C., (B.E., civil, Madras, India, 1950; M.Eng., structural, Nova Scotia Technical College, 1958); is under the auspices of the Colombo Plan associated with the St. Lawrence Seaway Authority. Professor Sundaram is a civil engineering department head at the A.C. College of Engineering and Technology, an affiliate of the University of Madras, South India.

Prof. P. S. Mani Sundaram, M.E.I.C.

R. B. Hill, JR.E.I.C.

C. Newton Hopkins, M.E.I.C., (B.A.Sc., chem., U.B.C., 1949), who joined Hooker Chemicals, Vancouver, in 1957, has been named plant engineer with the firm. Earlier he was associated with Canadian Industries Limited in several locations in Eastern Canada. He worked in various supervisory positions in operations and maintenance.

Robert C. Sadler, M.E.I.C., (H.N.C., mech., Worcester, England, 1951), former projects engineers in the Meter division, of Ferranti-Packard Electric Ltd., Toronto, is now senior mechanical engineer, electronics department, Stromberg-Carlson, San Diego, Calif.

Active in Institute affairs while in Canada, Mr. Sadler was a publicity chairman, on the P.D.P. directorate, Toronto, 1956-57; secretary-treasurer, 1957; chairman P.D.P. National committee 1957; and E.I.C. representative from Toronto to E.C.P.D. training committee meeting in Pittsburgh last May.

W. L. Dodson, M.E.I.C., (B.E., mech., N.S.T.C., 1946), has recently been promoted from assistant superintendent to superintendent of the heavy mills department, Dominion Iron and Steel Company, at Sydney, N.S.

Major David Veitch, M.E.I.C., CD, R.C.E., (B.Sc., civil, Queen's 1948), has been posted to the Royal Canadian School of Military Engineering, at Camp Chilliwack, B.C., as officer commanding, military engineering squadron. Major Veitch was formerly Canadian Engineer Liaison Officer to the Engineer-in-Chief, the War Office, London, England.

Claude Langlois, M.E.I.C., (B.Eng., civil, McGill, 1953), is a partner in the firm of Cote, Leclair & Langlois, consulting engineers in Sherbrooke, Que. Since graduation Mr. Langlois has added to his engineering skills in gaining experience with the Montreal consulting firm of Leblanc & Montpetit, 1953-1956, and with the Donahue Electric Company, Sherbrooke, Que.

Wm. Birks, M.E.I.C., (B.Sc., mech., Queen's, 1945), has been named manager of Du Pont Company of Canada's linear polyethylene plant being built in Sarnia. He was formerly operations manager of the plastics division of the company in Montreal. Earlier he was assistant works manager in the company's Shawinigan works.

James Craig, M.E.I.C. (B.Eng., civil Liverpool 1950) of the McColl-Frontenac Oil Company Ltd., Montreal East Refinery, has transferred his services to the Warnoc Hersey Co. Ltd., St. John's, Newfoundland, as branch manager. While in Montreal, Mr. Craig was design and construction engineer for the company.

Douglas S. Laidlaw, M.E.I.C, (B.A.Sc., civil, Toronto, 1928), of Ottawa, is project engineer for the R.C.A.F. maritime development, which consists of the construction of hangars and related facilities to house the Argus at Greenwood, N.S., and Summerside, P.E.I. The design phase is nearing completion and construction is underway.

Robert B. Hill, JR.E.I.C., (B.A.Sc., engineering and business, Toronto, 1950; M. Comm., business admin., Toronto), assistant to the vice-president of operations, Canada Iron Foundries Limited, for the past two years, has accepted an appointment as chief industrial engineer, Dominion Bridge Company Limited.

R. C. Hale, JR.E.I.C., (B.Sc., civil, New Brunswick, 1956), Athlone Fellow, has returned to Canada from Great Britain. A member of the Ocean Steel and Construction Company, St. John, N.B., his work is that of project engineer. Mr. Hale spent his first year in England at the London School of Economics and Political Science where he completed a post-graduate course in business administration. During the second year of the Fellowship his headquarters were at the Cleveland Bridge and Engineering Company, London.

John D. Riddle, JR.E.I.C.

John D. Riddle, JR.E.I.C., (B.A.Sc., mech., Toronto, 1953), product engineer with the S. A. Armstrong Co. Ltd., at Toronto, has been named chief engineer with the firm of Clarke-Parry Air Conditioning Ltd., also in that city.

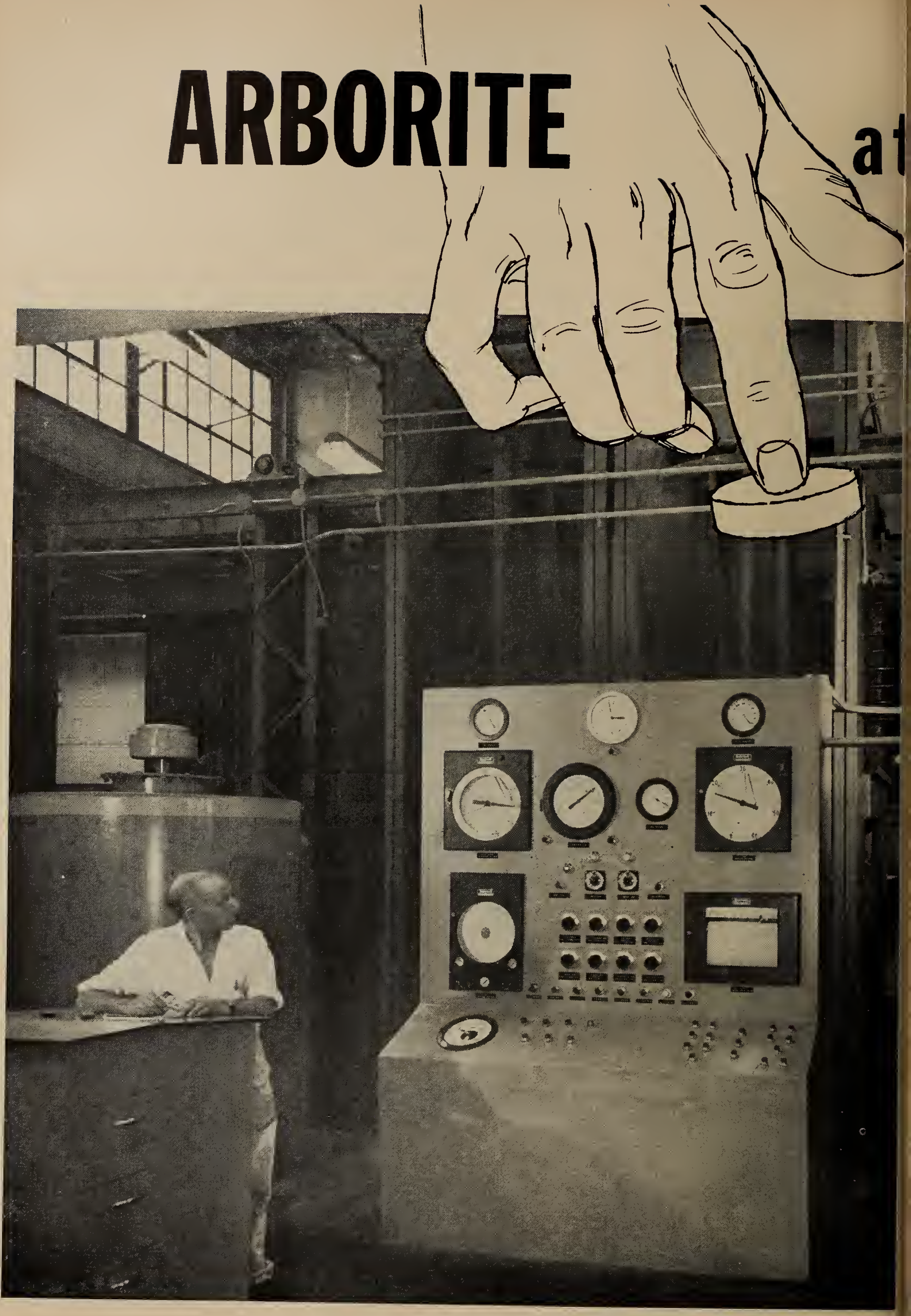
G. R. Naylor, JR.E.I.C., (B.Sc., elec., Manitoba, 1951), whose position was formerly sales engineer with Packard Electric Company Limited, Toronto, has been named co-ordinating engineer for Ferranti-Packard Electric Limited, St. Catharines, Ont. Mr. Naylor began his career with the British General Electric Company, Toronto, as junior engineer and estimator.

B. J. Armstrong, JR.E.I.C., (B.A.Sc., Engineering & Business, Toronto, 1955), has been named to represent a Canadian group in London, England. He is United Kingdom Technical representative for the Plywood Manufacturers Association of B.C. Earlier he represented the Association in Toronto.

E. R. Corneil, JR.E.I.C., (B.Sc., Mech., Queen's, 1955), is carrying on his engineering career in the field of education

B. J. Armstrong, JR.E.I.C.

ARBORITE at



• PERSONALS

as a lecturer at Queen's University, Kingston, in the Mechanical Engineering Department.

Mr. Corneil, an Athlone Fellow who recently returned to Canada, has for the past three years been following studies leading to a Ph.D. degree at Imperial College, University of London, London, England.

R. Lazar, JR.E.I.C.

Ronald Lazar, JR.E.I.C., (B.Sc., civil, Man., 1955; M.Sc. civil, Illinois 1957) a design engineer with Ammann & Whitney, consulting engineers, New York, has returned to Canada. Mr. Lazar holds the appointment of assistant professor in civil engineering, University of Manitoba.

Jean E. Villeneuve, JR.E.I.C. (B.Sc., civil, Laval, 1956), has completed studies made in Great Britain under the auspices of an Athlone Fellowship. Once again resident in Quebec City, he is employed with the St. Lawrence Construction Company Ltd.

Mr. Villeneuve was awarded a D.I.C. in concrete technology from Imperial College, London, England.

Mr. Villeneuve was president of Quebec City student branch EIC while attending Laval University.

Ralph W. Culley, S.E.I.C., (B.Sc., civil, Alberta 1958), works as a project engineer with the Department of Highways, Province of Saskatchewan, Yorkton, Sask.

Blaise Cliche, S.E.I.C., (B.A.Sc., metall., Ecole Polytechnique, 1958), is working in the Metallurgical Laboratory at Canadair Limited as Engineer "C".

J. E. Villeneuve, JR.E.I.C.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NEWS OF THE BRANCHES

Activities of the Fifty Branches of the Institute and abstracts of the papers presented at their meetings

BELLEVILLE

F. E. Moore, M.E.I.C., *Sec.-Treas.*

D. A. Law, JR.E.I.C., *Branch News Reporter*

Baie comeau, quebec was brought to the attention of the Branch at a November 10 meeting, by Allan Hughes of the C. D. Howe Company, Montreal, who gave an interesting and informal talk on the British Aluminum Company Dock at Baie Comeau, Que. Three technical papers on the subject having appeared in the *Journal*. Mr. Hughes restricted himself to some of the more interesting highlights of the 78 million dollar project. A number of coloured slides of the project including the dock smelter and townsite, illustrated the complexity and size of the operation, and impressed the group.

Mr. Hughes was entertained at dinner by the branch chairman, T. E. Flinn and M. A. Janitsch, who introduced the speaker.

Scholarship Awards

The Scholarship award of $25 was raised to $50, half of which would go to each of the secondary schools to the grade XIII student entering engineering with the highest standing in English, mathematics and science.

J. A. Grant, past chairman of the branch made the award to Jim Green at the Quinte Secondary School on October 17, 1958. Mr. Green received a total of $3200 in scholarships and prizes. This allowed him to start on an engineering education which would have been otherwise impossible. Besides being a remarkable student, he was also a top athlete.

Thomas Benger, M.E.I.C., vice-chairman, made a presentation of a branch award at the Belleville Collegiate and Vocational Institute, October 24, 1958. The student selected, carried away approximately $1200 in scholarships and prizes.

The Border Cities Branch executive with E.I.C. headquarters visitors on the occasion of a dinner-dance, Oct. 17, 1958. Back: l. to r., J. M. Reid, F. P. Mascarin, A. Barker, R. Darke, E. Dykeman, A. Malmberg, Front: Dr. L. A. Wright, general consultant, E.I.C., Dr. K. F. Tupper, president and Dr. Garnet T. Page, general secretary of the Institute.

The new executive of the Lower St. Lawrence Branch. Back row: l. to r., Roland Boisvert, director, Donald Caveen, sec.-treas., August Albert and Fernand Roy, directors. Front: Andre Leroux, director, Jean Menard, past-president, Leon-Paul Dancose, president, and Andre O. Michaud, vice-president.

BROCKVILLE

G. R. Bowes, JR.E.I.C., *Sec.-Treas.*

W. E. Morden, M.E.I.C., *Branch News Reporter*

Water and sewage problems in Canada were considered by about 40 members at a meeting devoted to the subject on October 27. Chief spokesman was J. J. Powell of Gore and Storrie, consulting engineers, Toronto. Mr. Powell outlined water and sewage problems in the Brockville area before describing wider national aspects, in terms of the various types of installations to be found across Canada.

As far as Brockville is concerned, the central part of the town was built some 60 years ago, and the sewage system was comprised of sanitary and storm pipes of only 8-inch diameter. It is now necessary to modify the system to take care of modern day practices, as well as the expanded population. The new areas on the outskirts of Brockville are equipped with 16-inch pipe lines for the sanitary and storm sewers. Complete modification of the town will have to await an integrated system comprising new mains, water pumping station at the west end, and also a revamped sewage system.

The new pumping station to cost $1,200,000 includes a water purification plant employing micro strainers, a 30" intake, plus a new main distribution piping system for the water supply. The

micro strainers, now standard with the industry in Canada, remove all vegetation and foreign material down to a size of 35 microns.

Mr. Powell showed slides of the water and sewage systems throughout Canada, including Cornwall, Kingston, Edmonton, Toronto, Peterborough, Trenton, etc.

The speaker was introduced by Walter Ashworth, of Automatic Electric Company, Brockville.

HALIFAX

W. J. Phillips, M.E.I.C.,
Branch News Correspondent

J. E. Reardon, M.E.I.C., *Sec.-Treas.*

Sir Claude Gibb, K.B.E., F.R.S., who, on visits to Canada has been a spokesman before the Branches on several occasions, addressed the Halifax Branch on October 27. Sir Claude is professionally associated with the firm of C. A. Parsons and Company, Newcastle-on-Tyne, England. His talk, "Developments in Nuclear and Orthodox Power Stations dealt mainly with the design and construction of the Bradwell Power station with special emphasis on the reactor and other allied auxilliaries. Recent trends in large thermal plant generators such as Parson's design for a 550 MW unit was mentioned. Current trends observed in the United States as a result of a recent visit to Oak Ridge and shipping port and the difference in American and British approach to fundamental design. Films and slides were used as a visual aid to his remarks.

J. A. McLaren, Eastern field secretary, was a recent visitor to Halifax. He attended the October meeting of the Branch executive, and heard Sir Claude's talk. At Wolfville, N.S., he addressed the engineering students at Acadia University, later attended an informal supper, meeting students and senior members of the Institute residing in the area.

At Bridgewater, N.S., a similar event took place. Mr. McLaren was accompanied by members of the Halifax Branch executive and other members of the Branch on each occasion.

The 1958 Golf Tournament, Eastern Townships Branch, Sept. 27. L. to r.: G. P. Cote, Branch chairman, R. Dugre, receiving Fabi Trophy from Sam Fabi, of Fabi and Fils Ltee; G. J. Cote, R. Payette, and J. Lemieux.

HAMILTON

J. R. Currie, M.E.I.C.,
Branch News Reporter

W. A. H. Filer, JR.E.I.C., *Sec.-Treas.*

The annual engineers' ball attracted about 200 couples for a good time at Fischers' Hotel on Friday, October 10.

Mr. and Mrs. Wm. Filer entertained some of the special guests at their home before the dance. Present for the occasion were H. G. Conn, Kingston, vice-president, E.I.C., and Mrs. Conn; C. T. Carson, Windsor, president of the Association of Professional Engineers of Ontario, and Mrs. Carson; Mr. and Mrs. Eric St. John, Montreal; Mr. and Mrs. L. Jacobson, Montreal; Mr. and Mrs. E. Sillett; Mr. and Mrs. R. C. Mitchell, chairman, Hamilton section, E.I.C., Mr. and Mrs. A. C. MacDonald.

KINGSTON

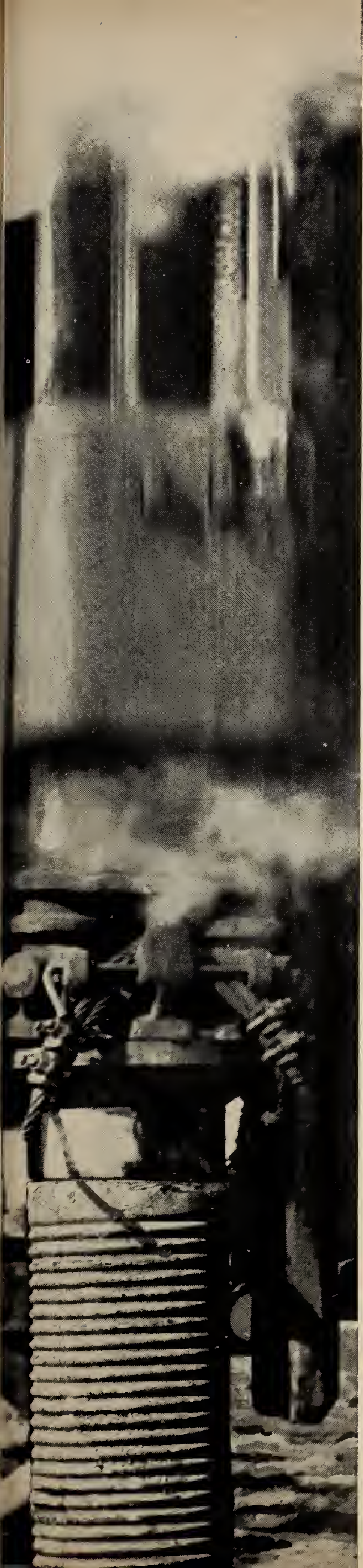
D. I. Ourom, JR.E.I.C., *Secretary and Branch News Reporter*

Dr. A. E. Berry, general manager of the Ontario Water Resources Commission outlined the functioning of the Ontario Water Resources Commission at a meeting held on September 23. He explained in some detail the reason for its existence and the service rendered to communities of all sizes. The terms of work, the matter of surveys, designs, construction and operation of water purification plants, sewerage disposal, and treatment works, which the Commission will undertake in a municipality, were put before the assembled members. The many problems confronting his department in supplying the province's growing water needs and solving pollution problems were discussed. Examples were given of work accomplished and that which remains to be done. The paper was well illustrated with slides showing the projects they have worked on to date.

Talk on Design Racing Yachts

"Some aspects of the Design of Racing Yachts," was the title of the remarks directed to Kingston members by Colonel Peter King at an October 21st meeting. Colonel King, retired head, department of mechanical engineering, Royal Military College, Kingston, is an associate professor, mechanical engineering at Queen's University.

The factors governing the design of racing yachts, the structural strength necessary to such a boat, and the form of the hull, were discussed. To give his audience some idea of the effects of wind and wave on hull and rigging, and



how to resolve this problem, Col. King outlined the structural features and consideration. Hull shapes, advantages and disadvantages of the small changes which can be made within the rules set down for racing yachts was explained. Illustration, with a model racing yacht, clarified the basic methods for transferring a selected design into the necessary transverse, longitudinal and diagonal cross sections.

Colonel King showed a number of slides of an aluminum alloy framed 28 ft. yacht which he is building, and pointed out valuable and poor design features.

After a discussion, past-president L. F. Grant discussed the recent America Cup Races at Newport, R.I. which he attended. Referring to Colonel King's paper he explained the reasons for Sceptre's defeat.

KITCHENER

John F. Runge, M.E.I.C.,
Branch News Reporter

A. H. Austin, JR.E.I.C., *Sec.-Treas.*

A FIELD TRIP to the sponge rubber division, Dominion Rubber Company, Merchants Rubber Factory, Kitchener, Ont., on October 31 was enjoyed and described as excellent by the Kitchener Branch.

The visit was made to the Koylon foam rubber plant, the most recently constructed plant in Canada devoted solely to the production of foam rubber. For this reason it has the newest and latest equipment available.

The production of foam rubber is primarily a chemical process which is dependent on mechanical processing and control equipment for effective and efficient processing.

A general talk on the foam rubber process preceded Laboratory demonstration of foam production and a tour was made of the manufacturing facilities.

KOOTENAY

G. T. J. Hughes, M.E.I.C.,
Branch News Reporter

J. L. P. Limbert, JR.E.I.C., *Secretary*

THE LATE S. C. MONTGOMERY, vice-president E.I.C., Western region, gave a brief report of Zone A activities at a recent meeting of the Branch. Under the chairmanship of J. T. Higgins, councillor W. K. Goyer presented a comprehensive report covering all aspects of the conference held in Quebec.

Mr. Higgins added an appeal to all members of the Branch to submit papers on various aspects and subjects relating to this work for inclusion in Branch programs.

European Tour

W. G. Small, past Branch chairman showed slides of his European tour of Belgium, Great Britain, France and Portugal. Highlight of the trip was an absorbing visit to the World Fair in Brussels. Mr. Small delighted the audience with his impressions of the various buildings, including the U.S.S.R. pavillion and the renowned structure, the Atomium.

A witty commentary accompanied the slide showing.

LETHBRIDGE

R. F. Smith, JR.E.I.C., *Sec.-Treas.*

G. Campbell, JR.E.I.C.,
Branch News Reporter

THE ANNUAL JOINT dinner meeting with the Association of Professional Engineers of Alberta, held October 25 drew an attendance of fifty persons.

Deputy Mayor J. Wilton extended a cordial welcome on behalf of the City to Dr. Govier, guest speaker, and A.P.E.A. president, visitors and engineers.

Dr. Govier stressed the existence of chemical and petroleum engineering, University of Alberta, and a member of the petroleum and natural gas conservation board of Alberta.

Dr. Govier is head, department of the A.P.E.A. for protection of the public, on the authority of the Alberta Legislature. Appointed for maintenance of

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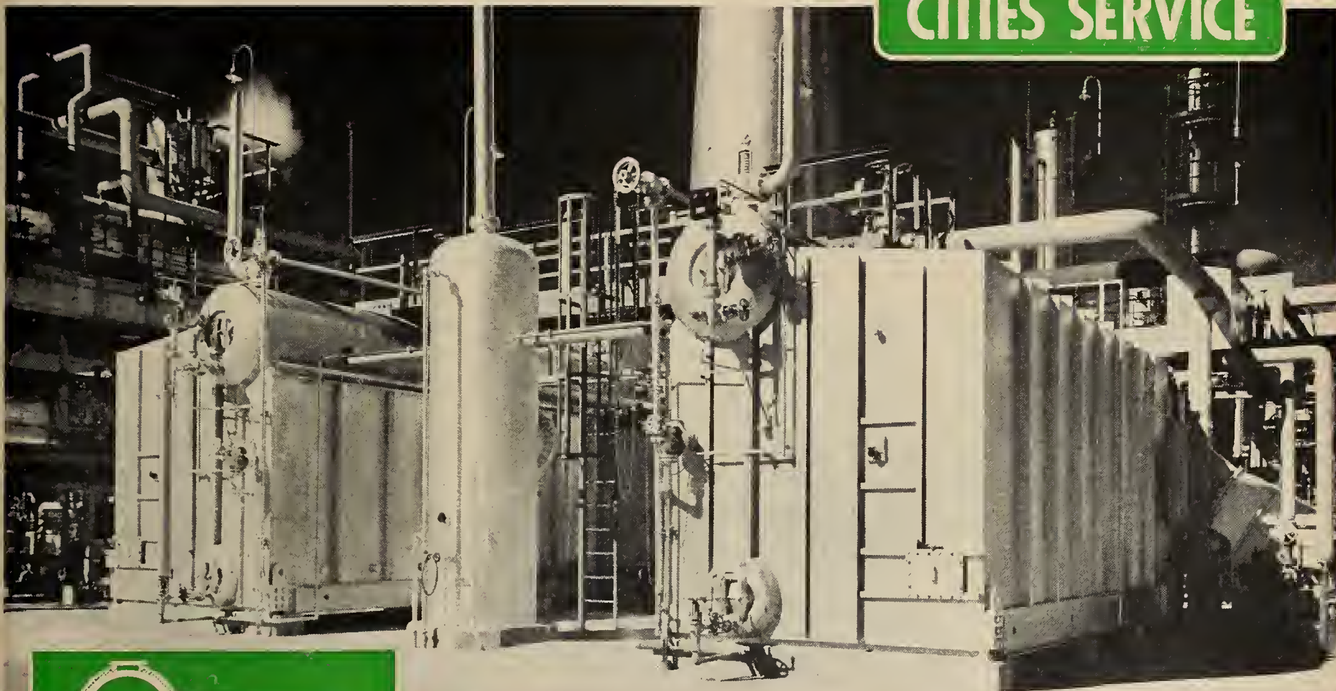
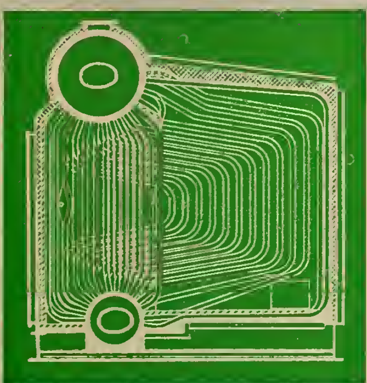


Two AG-246 units, each capable of generating 50,000 lbs/hr sold to C. F. Braun & Co. of Canada Ltd. and installed at the new Cities Service Refinery at Trafalgar, Ontario.



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AG-244	52,500	50,000	24'6"	11'2¼"	13'6"
AG-246	55,000	52,300	25'6¾"	11'2¼"	13'6"
AG-248	57,500	54,600	26'7½"	11'2¼"	13'6"
AG-250	60,000	56,900	27'8¼"	11'2¼"	13'6"
AG-252	62,500	59,200	28'9"	11'2¼"	13'6"

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Dr. Govier suggested a change in regulations of the A.P.E.A. so that members such as geophysicists could be designated by their title, i.e., P. Geoph. or P. Geol. rather than P. Eng. He pointed out that all engineers, geophysicists, and physical scientists with the proper requirements should be members of the A.P.E.A. The professional affairs of the three groups are identical.

LONDON

G. W. Chorley, M.E.I.C.,
Branch News Reporter

W. C. Sinkins, JR.E.I.C., *Sec.-Treas.*

An annual joint meeting of the London branches of the E.I.C. and the Association of Professional Engineers of Ontario was held on October 14, 1958. C. T. Carson, president of the latter group and a member of the E.I.C. made a presentation of certificates of registration to two professional engineers. Mr. Carson addressed the meeting on some of the activities of the Association. He explained the reasons behind the recent salary survey and subsequent "Report on Salaries" that was issued to all Professional Engineers. Mr. Carson also spoke on the subject of improving the status of professional engineers.

Gordon McHenry, P.Eng., vice-president of the Association and member of council, was introduced and spoke briefly on Association affairs. Mr. Carson was accompanied by Blake Goodings, P.Eng., field representative of the Association and J. MacLaren, P.Eng., field secretary of the Institute.

NIPISSING AND UPPER OTTAWA

R. A. Booy, JR.E.I.C., *Sec.-Treas.*

R. D. Christie, JR.E.I.C.,
Branch News Reporter

The October meeting held on October 8 featured an informal talk by V. Wolchick of Trans-Canada Pipelines. Mr. Wolchick is superintendent on the Kapuskasing-Toronto section of the line. He was very recently in charge of line location and construction on the Kapuskasing-Toronto section of the line. The route follows Highway 11 closely all the way, to provide easy access. This is considered to be the economical location, even though a cross-country route from the Lakehead to Southern Ontario would have saved several hundred miles of pipe.

An interesting feature of line location is that it is cheaper to turn the pipe and go squarely up the face of a hill than it is to run straight up a diagonal. The reasons are: easier road-building for the pipe-stringing equipment, and less danger of erosion shifting the finished line.

The line was built on contract in seven sections, with each contract sized to finish in the same time. The longest section is 92 miles, mainly through soil at the Toronto end of line, the shortest section is 43 miles through the hardrock at Temagami.

The compressor station at North Bay, currently the only station between the Lakehead and Toronto, has three gas-operated 1800 HP compressors and provisions for three more to be installed later. The compressors are reversible so that in case of a line failure in Northern Ontario, North Bay can feed Texas or Ontario gas back up the line to the point of failure. In normal operation North Bay expects to receive gas from the north at about 450 lb. pressure and raise this to 700-800 lb. output.

Construction of more compressor stations and another parallel pipeline are expected to start soon. Eventually there will be a compressor station every 80 miles along the line with all pressures monitored at North Bay.

An interesting point was brought out concerning weights used on water cross-

ings. Ordinary concrete is only 50 per cent efficient for this purpose due to its buoyancy in mud. Special concrete using iron ore aggregate, giving an efficiency of 60 per cent was used extensively. Metal weights which were used in some muskeg crossings have an efficiency of 80 per cent.

Mr. Wolchick ended his talk with a word for young engineers: Experience is far more important than education when you are looking for advancement, and you can only gain good experience by exercising patience.

NORTHERN NEW BRUNSWICK

Stewart K. Henry, JR.E.I.C., *Sec.-Treas., and Branch News Reporter*

A GENERAL MEETING was held at the Chateau Restigouche Hotel, Campbellton, N.B., October 1, attended by 17 engineers.

T. H. McSorley introduced the speaker of the evening, G. B. Lawson, who until recently was a design engineer with Fraser Company in Edmundston and is presently associated with Fraser Company sales division, Montreal. Mr. Lawson gave an interesting and aptly illustrated paper on the new Steam Plant Extension at Fraser Co.'s Edmundston mill, which produces pulp for the Fraser Company's paper mill in Madawaska, Maine. He initially traced the history of the Edmundston Steam plant to date. The latest extension, initiated in 1956, was constructed to meet the increased production capacity and additional power requirements of the mill. It centered about (1) a new Combustion Engineering H.P. boiler rated at 1250 lbs. pressure and 950°F, (2) a 12,500 Kw extraction turbine and (3) additional feedwater treatment equipment.

It was pointed out that while the Fraser Co. mills at Madawaska and Edmundston have separate power plants, they are connected by a 10,000 KW tie line and therefore it was necessary to consider the two mills jointly in setting up the latest expansion. The speaker then described the operational aspects of the re-vamped plant with the aid of a flow diagram. He stated that the prime object of the plant was to obtain the maximum amount of power at any time; to this aim the new boiler is always run at full capacity and the other two existing 600 lbs. boilers are set to take care of any fluctuations in load. The new boiler went into service on June 16, 1958 and the new turbine was expected to be in service by October 9, 1958.

The speaker was ably thanked on behalf of the Branch by A. W. Rowe. It was moved and seconded that the meeting adjourn. The meeting then retired to the Chateau Bar-B-Cue when a delicious lunch was served.

PETERBOROUGH BRANCH

G. M. Locke, JR.E.I.C., *Sec.-Treas.*

J. G. Hooper, M.E.I.C.,
Branch News Reporter

THE FIRST TECHNICAL ACTIVITY of the Branch for the fall season was a most enlightening visit to Atomic Energy of Canada Limited at Chalk River by 40 branch members on October 18.

Welcome was extended by C. A. Crawford, chairman of the Chalk River Branch of the Institute who also served as guide for one of the four tour groups. An introduction and brief illustrated address on the project preceded the tour. A fortifying lunch was served at the project cafeteria.

The groups were shown the universal cell• and the Canadair designed pool test reactor in detail and later all parts of the NRX and NRU reactor buildings. This opportunity to see these developments first-hand and to have all questions ably and graphically answered proved an ideal means of introducing most of those present to the fundamentals of atomic research and the achievements and problems in practical application of this most recent development in energy harnessing.

The attending group included a good cross-section of those members not already familiar with the work at Chalk River through their work at the Civilian Atomic Power Development at Canadian General Electric Company in Peterborough. All present were enthusiastic about

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SASKATOON SECTION

R. Bing-Wo, M.E.I.C., *Sec.-Treas.*

Roger Dupuis, M.E.I.C.,
Branch News Reporter

ECONOMIC NUCLEAR POWER PLANTS were to be looked for in Canada in from five to ten years time, according to J. L. Olsen, sales manager, civilian atomic power department, Canadian General Electric Company, Toronto. Sixty engineers heard the talk which dealt with Canadian Progress Toward Economic Nuclear Power, at an October 9 meeting.

Mr. Olsen said nuclear power plants could be made economic in areas where cost of other energy fuels was high, particularly coal. Ontario had been served well with cheap hydro-electric energy, but had reached its last source in the St. Lawrence Seaway. To meet its expanding needs from this type of energy it would have to go further and further north and it would become more costly. He thought Ontario would have to turn to some form of thermo-nuclear energy.

Using coal as a fuel, electric energy could be produced for two mills per kilowatt hour. Mr. Olsen said that Canadian General Electric believed, judging by development to date, that atomic power plants could be built that would produce electrical energy for a cost less than two mills per kilowatt hour.

Canada had from the start adopted the right concept for the development of nuclear energy, Mr. Olsen said. This country could produce atomic power plants more economically than any country in the world.

At Chalk River, Canadian scientists had developed production of nuclear energy using natural uranium which was mined at several places in this country and therefore relatively cheap as a fuel.

ST. MAURICE VALLEY

J. Carson, JR.E.I.C., *Secretary*

E. A. Love, JR.E.I.C.,
Branch News Reporter

CHINESE JOURNALIST and lawyer, Dr. L. E. Tsao, addressed the Branch at the October 22 meeting. Dr. Tsao's address was entitled "China and its Place in the World Today."

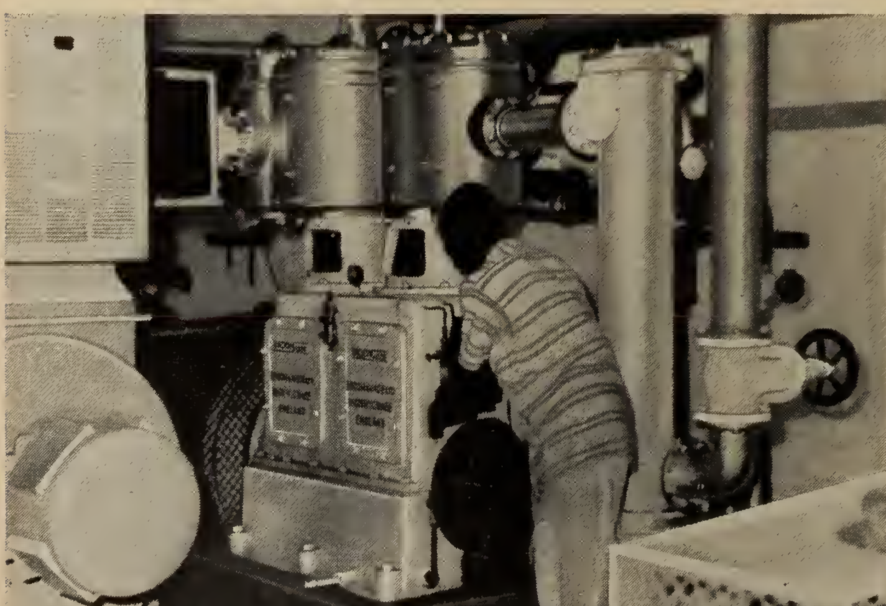
In his opening remarks Dr. Tsao pleaded the value of better understanding between East and West. He pointed out that the East had evolved a civilization based on culture, heavily laden with spiritual and artistic development, which had gone on for hundreds of years prior to contact with the West. During the last two hundred years, contact with the West had wrought abrupt changes, with Western ways more or less forced on the East. A series of wars which began in 1840, the so-called Opium Wars, wrested concession after concession from China. After years of absolute monarchy China became a constitutional monarchy under British influence; followed by the regime of Chiang Kai Shek. Both of these were of course unsuccessful legislation for China, and gave way to the experiment of Communism now being tried. Dr. Tsao explained that China is looking for an identity. The present regime will not endure, he thought, because of the need of the country to continue to grow.

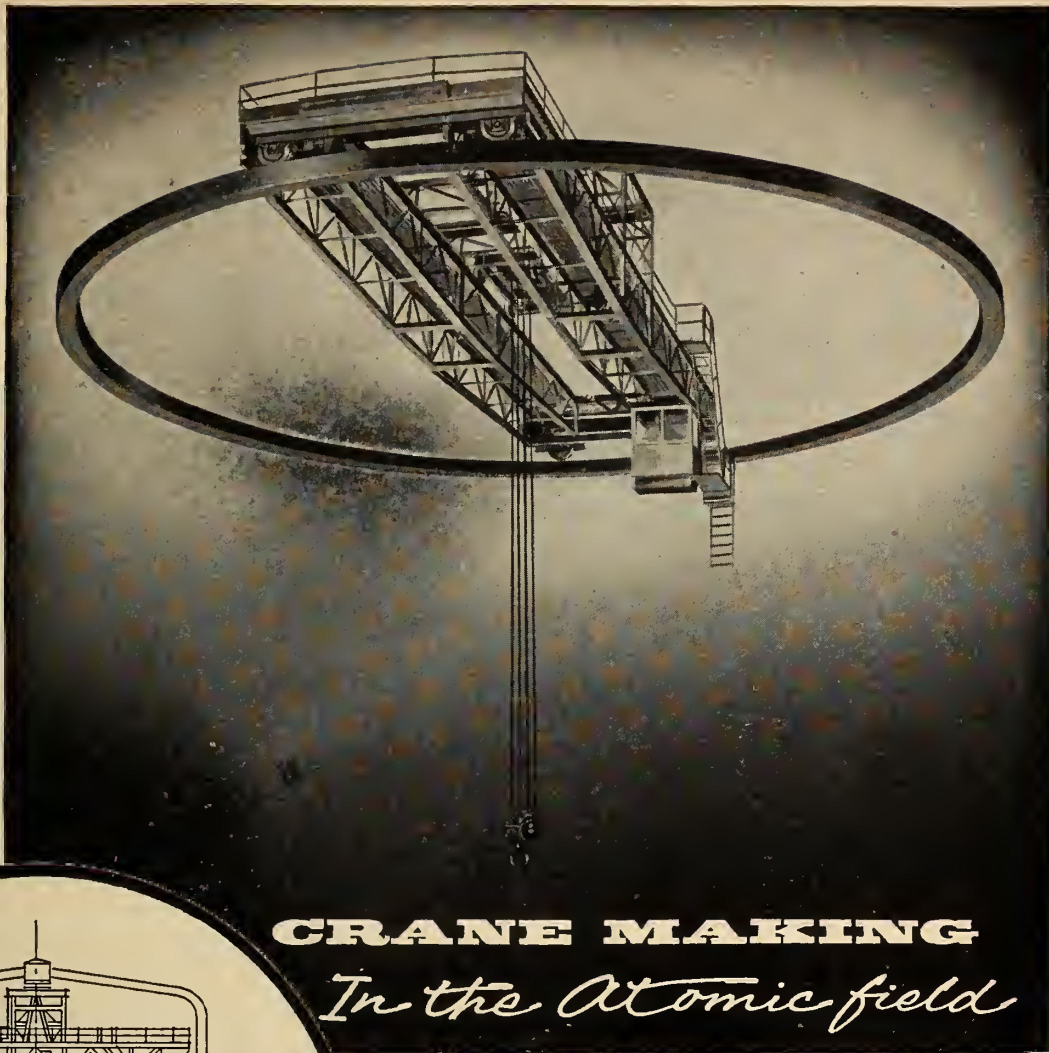
Dr. Tsao was introduced by J. V. Moreau and thanked by George Low. A very interesting question period followed.

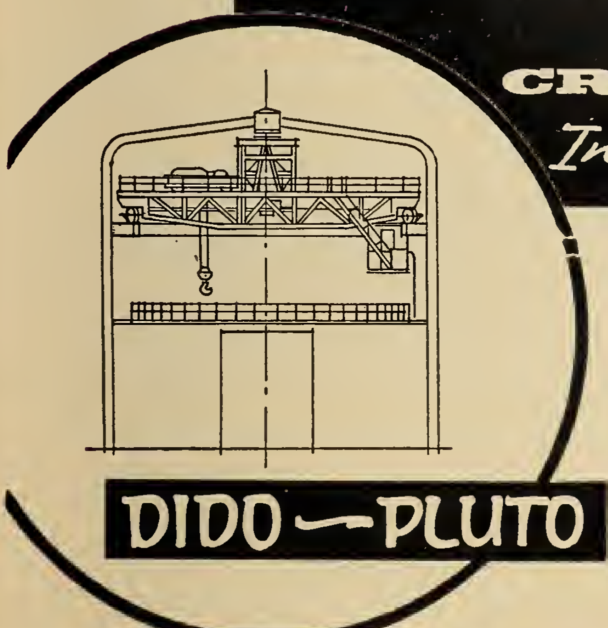
Bursary Awarded

Early this year the Thomas Berlinguet Bursary was awarded to Bernard Beland of Laval University by the St. Maurice Valley Branch in commemoration of the late Mr. Thomas Berlinguet's long association with the E.I.C. Mr. Berlinguet was the oldest member of the Institute at the time of his death at the age of 102.

The scholarship to Laval University was made out for $102. as a reminder of







In collaboration with the Ministry of Works Engineering Staff we designed and installed a special form of circular motion 20 ton Overhead Electric Travelling Crane of approximately 67 ft. span for operation in Britain's first experimental Reactor at Harwell.

In addition to this crane further circular motion units are operating in the United Kingdom in experimental Reactors at Harwell, materials testing Reactor at Dounreay and for the Australian Atomic Energy Commission Experimental Reactor at Lucas Heights Near Sydney. Other prominent cranes we have installed at Atomic Energy Projects are the Main Turbine House and Blower House cranes for Calder Hall and Chapelcross Atomic Power Stations. Currently we are engaged in the design and development of other special feature cranes in connection with British Industry in the building of Nuclear Energy Stations for the Central Electricity Authority in the United Kingdom.

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the revered age of the engineer it honoured.

The presentation was made by Dr. Berlinguet, grand-son of Thomas Berlinguet.

This bursary was presented by the St. Maurice Valley Branch in accordance with the decision of the Branch last year immediately following the death of Mr. Berlinguet, to aid a deserving student from the St. Maurice Valley attending the second or third year engineering course at Laval.

SAULT STE. MARIE

R. L. Wimperis, JR.E.I.C., *Sec.-Treas.*

Two FILMS prepared by the Bell Telephone Company were on the program for the October 17 meeting of the Sault Ste. Marie Branch. One film concerned the micro-relay system which stretches across Canada from coast to coast for the T.V. network, and for long distance phone calls. The Mid-Canada Early Warning Line was the subject of the other film. Some of the construction and transportation problems involved were outlined, and the use of crawler tractor trains and helicopters was shown. Basically non-technical but well made, each film made clear the principles involved, were of general interest and can therefore be highly recommended.

Golf Tournament

Over 150 engineers and their guests turned out for the 4th Annual E.S.J.C. Golf Tournament at the Ki-8-Eb Club on Friday, August 15. Under the guidance of Match Committee chairman Wally Seline, the engineers produced some very creditable scores.

Following the tournament, a gathering of over two hundred enjoyed a buffet supper and refreshments. Charles Gagnon, president of Ki-8-Eb, welcomed all to the club and expressed the hope that the tournament would be held there again next year.

Guest speaker for the evening was Baz O'Meara, prominent sports columnist of the Montreal Star. Although he has been a newspaperman for over 30 years, this was his first trip to Three Rivers and he hoped it wouldn't be his last.

He covered many phases of sport including; baseball, football, hockey, and golf, and told the gathering some of the background of sports in Montreal and Quebec Province.

The evening concluded with the presentation of over 50 prizes to the lucky golfers. Don Peach of Shawinigan, won the John F. Wickenden, championship cup for low gross, with a score of 73. This compares with a 94 posted by Louis Boivin the first tournament winner four years ago. Mr. R. L. Bouchard captured the "Engineers' Pot" for high gross.

Riches from the Untamed Mountains

This is the Rocky Mountain Rift, 500 miles North of Vancouver. With BTH acting as electrical advisers, ambitious plans are in hand to develop this remote, virgin territory for its raw materials and power resources. Present schemes envisage the possibility of the world's largest man-made lake, taking 7 years to fill, and having a hydro-power potential of some 4,000,000 h.p.

To tame these mountains calls for endeavour and hardship in one of the greatest modern pioneering jobs. BTH are proud to be numbered among the pioneers.

Recent BTH Contributions to Canada's Industrial Growth

* Toronto's modern subway has 140 railcars fitted with BTH traction control equipment.
* Generating equipment of 25,000 kW for the Ford Motor Company of Canada.
* 230,000-volt, 7,500 MVA lenticular circuit breakers for the B.C. Electric Company.
* The largest blast furnace blower of its kind, for the Algoma Steel Corporation.
* Mercury-arc rectifiers, transformers and switchgear for the Canadian British Aluminium Company's Baiecomeau Smelting Plant.

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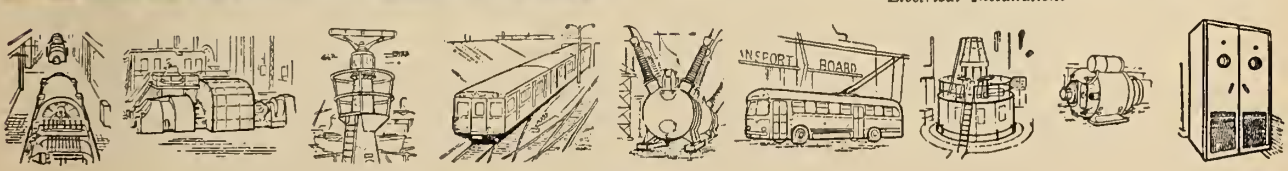

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News of Other Societies

American Society of Civil Engineers

The annual convention of the ASCE, was held on October 13-17, 1958 at the Hotel Statler-Hilton, New York City. Several joint sessions were held with the International Association of Bridge and Structural Engineers. Fourteen European engineers, representing eight countries, presented papers with 14 U.S. engineers at joint sessions of the society's structural, engineering mechanics and construction divisions, during the five-day program.

Prescott Bush, U.S. Senator from Connecticut and member of the Senate subcommittee on housing, guest speaker, discussed urban redevelopment. Problems related to the construction of buildings on ground with permafrost condition invoked special interest.

The Institute's award of merit went to James R. Killian, special assistant to the president of the U.S. for science and technology.

The retirement, after 28 years of service, of Walter E. Jessup, editor of Civil Engineering, the official publication of the ASCE, was announced. Succeeding him as editor of the publication of the 42,000 member society was Hal W. Hunt.

Francis S. Friel, of Philadelphia, designated as official nominee for president of the Society in 1959, took over the office from Louis R. Howson, Chicago. Two new vice-presidents and seven directors were installed.

Calendar

National Association of Corrosion Engineers
Eastern Regional Meeting, Sheraton-Mount Royal, Montreal, Jan. 12-14, 1959. Company exhibits covering all phases of products and services related to corrosion included.

Society of Automotive Engineers, Inc.
Annual Meeting and Engineering Display, Sheraton-Cadillac and Hotel Statler, Detroit, Jan. 12-16, 1959.

American Institute of Electrical Engineers
Institute of Radio Engineers, National Symposium on Reliability and Quality Control, Philadelphia, Jan. 12-14.

American Society of Heating and Air-Conditioning Engineers.
65th Annual Meeting and 14th International Exposition, Philadelphia, Jan. 26-30.

National Concrete Products Association
Tenth Anniversary Convention, Toronto, Jan. 26-28, 1959. Write: Alex Wylie, Suite 1604, 55 York Street, Toronto.

American Institute of Electrical Engineers
Winter General Meeting, New York, Feb. 1-6, 1959.

Materials Handling Analysis
Second Annual Midwest Work Course, Kansas City, Feb. 2-6, 1959. Limited enrollment of not more than 20 enrollees. For details write: Edward S. Avison, University of Kansas Extension Centre, 39th and Rainbow Blvd., Kansas City.

Society of the Plastics Industry
14th Conference of the Reinforced Plastics Division, Chicago, Ill. Feb. 3-5.

Eastern Snow Conference
1959 Meeting Commander Hotel, and MIT, Cambridge, Mass., Feb. 5-6, 1959. Write: Gordon R. Ayer, Secretary, Eastern Snow Conference, P.O. Box 948, Albany 1, N.Y.

Institute of Radio Engineers, American Institute of Electrical Engineers
Transistor and Solid State Circuits Conference, Philadelphia, Pa. Feb. 12-13.

American Institute of Mining, Metallurgical, and Petroleum Engineers Inc.
Annual Meeting, San Francisco, Cal., Feb. 15-19.

Chemical Institute of Canada
Annual Divisional Conference of the Protective Coatings Subject Division, Toronto, February 19, 1959, repeated in Montreal on Feb. 20, 1959.

Steel Founders' Society of America
57th Annual Meeting. Drake Hotel, Chicago, March 9-10, 1959.

Society of Automotive Engineers, Inc.
National Passenger Car, Body and Materials Meeting. The Sheraton-Cadillac Hotel, Detroit, Mar. 16-18, 1959.

National Association of Corrosion Engineers
The 15th Annual NACE Conference, and the 1959 Corrosion show, Chicago, March 16-20, 1959. Write: NACE, 1601 M & M Bldg., Houston 2, Texas.

American Institute of Chemical Engineers
National Meeting, Atlantic City, N.J., Mar. 16-20.

National Association of Corrosion Engineers
15th Annual Conference, Chicago, Ill. Mar. 16-20.

Institute of Radio Engineers
National Convention, New York, Mar. 23-26.

International Union of Pure and Applied Chemistry and the Chemical Society
International Conference on Co-ordination Chemistry, London, England, Apr. 6-11, 1959.

OFFICERS

Society of Naval Architects and Marine Engineers

At the annual meeting of The Society of Naval Architects and Marine Engineers, concluded on November 15, 1958, Rear Admiral Albert G. Mumma, United States Navy, was elected president of the Society for a two-year term starting on January 1, 1959. Admiral Mumma, who is chief of the Bureau of Ships, Department of the Navy, succeeds Walter L. Green, chairman of the board, American Bureau of Shipping, New York.

Plywood Manufacturers Association of British Columbia

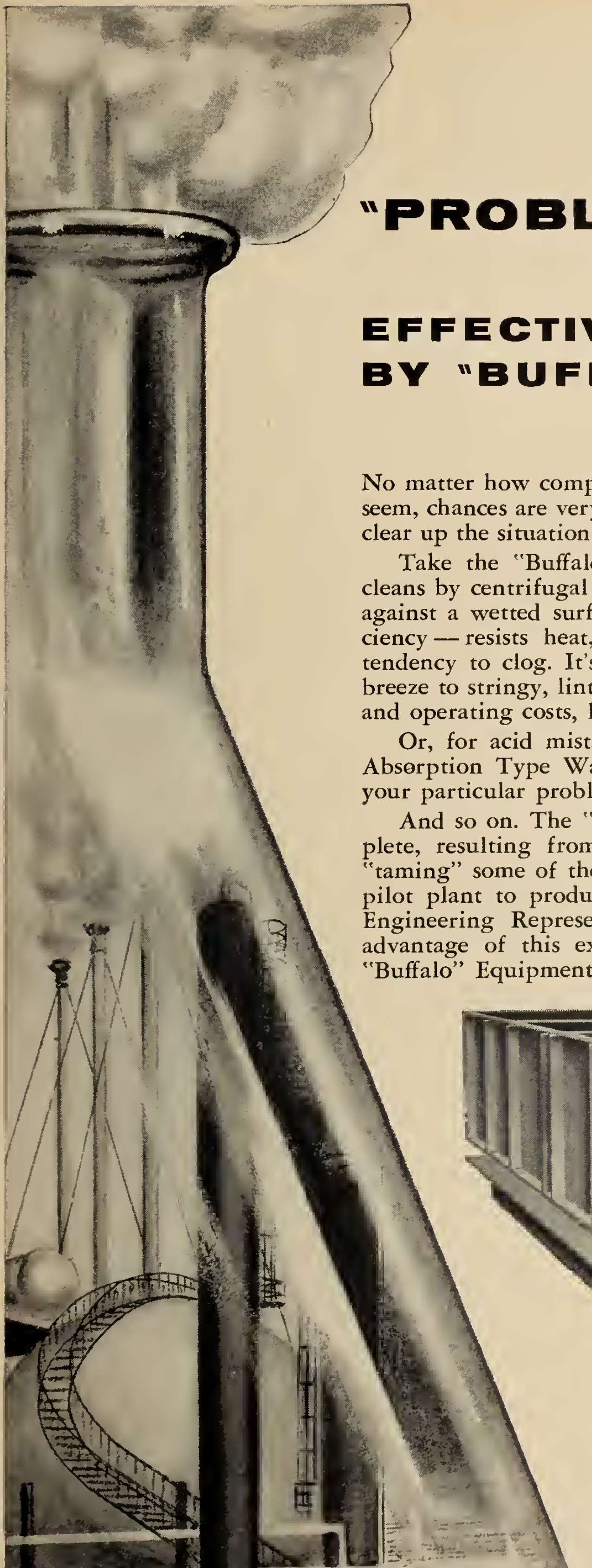
Two engineers, one an agricultural specialist, have been added to the field representative staff of the Plywood Manufacturers Association of B.C. Harvey P. Vokey, will operate the Montreal office, and G. Alexander Dring, will be stationed in London, Ont. Former London representative P. G. Willson has been moved to Toronto.

NOTICES

Safe Driving Week

Safe-Driving Week, a national campaign to impress the motorist and pedestrian with his responsibility, as an individual in preventing traffic accidents, was sponsored nationally by the Canadian Highway Safety Conference from December first to seventh, inclusive.

George B. Kenney, chairman, Canadian Highway Safety Conference called on every motorist and pedestrian to co-operate. Referring to a recent forecast of 3,400 traffic deaths in Canada in 1958 he said "more than 90 per cent of those deaths could be prevented if the individual driver and walker realized his responsibilty as an individual, in driving and walking safely.



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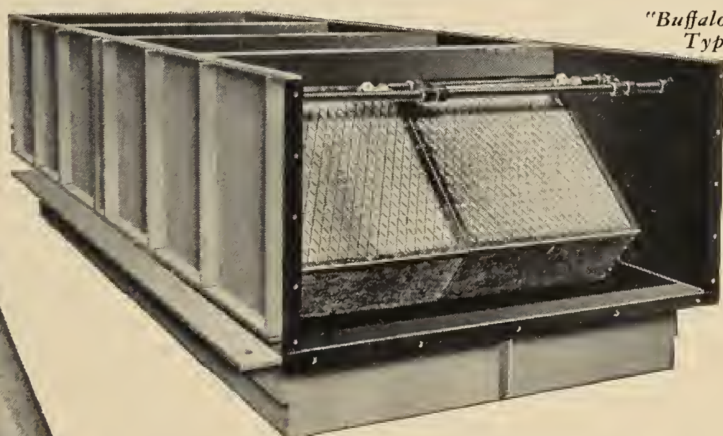

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BOOK NOTES

Prepared by the Library, The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

THE STRENGTH TO MOVE A MOUNTAIN

When the two hundred thousandth ship sailed through the Panama Canal in October 1957, the author was there to help celebrate the event. This volume is the story of the building of the Canal from the first disastrous French attempt to its completion in 1914, at a total cost of over $600,000,000. It is the record of a fight against climate, disease, inefficiency and the earth itself. It makes fascinating reading. (W. Storrs Lee. New York, Putnam, 1958. 318p., $5.00.)

DIFFERENTIAL EQUATIONS

Reprinted from the 1930 edition, this volume presents a treatment of all the processes for solving differential equations that have wide applicability. It does not consider elementary or partial differential equations. (F. R. Moulton. New York, Dover, Toronto, McClelland and Stewart, 1958. 395p., $2.00.)

MATHEMATICAL TABLES, 2ND ED.

These tables of elementary and some higher mathematical functions include squares, cubes, square and cube roots, reciprocals and natural logarithms. The main part of the work consists of tables of trigonometric functions, the exponential function, and hyperbolic and bessel functions. It covers almost every function of importance in applied mechanics, engineering and the physical sciences. (H. B. Dwight. New York, Dover, Toronto, McClelland and Stewart, 1958. 217p., $1.75.)

BASICS OF DIGITAL COMPUTERS

Another in the series of "Basic" books issued by Rider, this volume covers the knowledge of electronic computers required by technicians and others in the field. The first volume reviews the development of computers, and explains the basic theory of computer arithmetic, data representation, the programme and control. The second volume discusses the elements, circuits, magnetic cores, etc., found in a computer, while the last volume considers memory, control system, input and output equipment and timing. (J. S. Murphy. New York, Rider, 1958. 3 vols., $2.50 per vol., $6.95 a set.)

ELECTROSTATICS

This volume uses a mathematical treatment in discussing the behaviour of electrical charges at rest, that is, electrostatics. The topics covered include matter and electric charges, unit systems, the nature and characteristics of the electric field, electric potential, capacitance and capacitors, and electrostatic devices and applications. (A. Schure, New York, Rider, 1958. 64p., $1.35.)

*THE ELEVATED-TEMPERATURE PROPERTIES OF WELD-DEPOSITED METAL AND WELDMENTS

Provides data for carbon, low-alloyed and austenitic steels, and for complex alloys developed for high strength at high temperatures. Among the data included are short-time tensile properties, creep and rupture strength, and chemical composition. Wherever possible the properties of the welds are related to the properties which are characteristic of the base alloys. (Philadelphia, American Society for Testing Materials, 1958. 223p., $5.50. s.t.p. no. 226.)

*SYMPOSIUM ON NONDESTRUCTIVE TESTS IN THE FIELD OF NUCLEAR ENERGY

Surveys ultrasonic, radiation, and eddy current methods and techniques. The majority of the papers included discuss applications in the inspection of castings, tubing, unclad fuel element components, and clad fuel elements. (Philadelphia, American Society for Testing Materials, 1958. 395p., $10.00. s.t.p. no. 223.)

*SYMPOSIUM ON RADIATION EFFECTS ON MATERIALS—VOLUME 2

Twelve papers dealing with the interpretation of existing code and specification values as they apply to nuclear reactor structures and components. Two deal with consideration of radiation effects in design, five with radiation facilities and techniques, and five with various materials. (Philadelphia, American Society for Testing Materials, 1958. 137p. $3.75. s.t.p. no. 220.)

TECHNIQUES OF PLANT MAINTENANCE AND ENGINEERING, 1958

This ninth volume in the series covers the proceedings of the conference held in January 1958. The majority of the 35 papers are generally applicable in all industries. Several, as well as the round table discussions, are concerned with problems in specific industries and plants. These are metal working, petroleum processing, rubber, chemical, metal fabricating, food processing, foundries, steel mills and pulp and paper mills. As usual, a wide variety of maintenance topics is discussed, and many ideas presented which are of value to maintenance engineers in both small and large plants. (New York, Clapp and Poliak, 1958. 211p., $10.00.)

HISTORY OF MATHEMATICS

Reprinted from the 1953 edition, these two volumes cover the history of mathematics from the earliest times to the end of the nineteenth centruy. The first volume is arranged chronologically by man and country, and the second by subject, discussing the evolution of the different divisions of mathematics. The author discusses all the major figures in the field, in all countries, in a most readable manner. Both volumes are generously illustrated, and there are many bibliographical references for those interested in pursuing any particular topic further. (D. E. Smith. New York, Dover, Toronto, McClelland and Stewart, 1958. 2 vols., $5.50.)

THE ENGINEERING INSTITUTE LIBRARY

The publications mentioned in these Notes are now available in the Library. Members of the Institute may borrow books, periodicals, pamphlets, etc. from the Library. The loan period is two weeks, excluding time in transit, and two items may be borrowed at one time. Library hours are: Monday to Friday: 9 a.m.—5 p.m.; Saturday: 9 a.m.—12 noon.

Because of a recent change in policy, publications (except periodicals published by other engineering societies) may no longer be purchased through the Library. If members have difficulty obtaining material locally, it is suggested they write to the Library, and the enquiry will be forwarded to an appropriate bookseller. For further information write to the Librarian.

• LIBRARY NOTES

PROCEEDINGS OF THE EIA CONFERENCE ON MAINTAINABILITY OF ELECTRONIC EQUIPMENT

At this conference sponsored by the Electronic Industries Association held in 1957, sixteen papers were presented on the subjects of maintainability concepts and requirements, and the maintainability of ground, airborne and missile equipment. The participants in the Conference were all top engineers in both the military services and industry. (New York, Engineering Publishers, Interscience, 1958. 104p., $5.00.)

THE PRINCIPLES OF TECHNICAL ELECTRICITY, 3RD ED.

Intended for students, this volume is concerned with the fundamental principles of electricity, especially with reference to its technical applications. The introductory topics discussed include electrolysis, the accumulator, electrostatics, condensers, magnetism, etc. The final chapters cover A.C. circuit theory, valves, radio circuits and the cathode-ray oscillograph. (M. Nelkon. London, Blackie, 1958. 250p., 15/-.)

*TECHNICAL EDITING

Presents the basic concepts and practices of internal communications, journal editing, book publishing, and graphic arts as related to the technical field. The papers are written by persons engaged in these activities and provide a practical approach. (Ed. by B. H. Weil. New York, Reinhold, 1958. 278p., $5.75.)

*INTRODUCTION TO NUCLEAR ENGINEERING, 2ND ED.

Major emphasis has been placed on those aspects of engineering practice unique to nuclear engineering. This edition contains two new chapters. The first deals with reactor core design and discusses burnout, hot channel factors and related problems. The second discusses thermonuclear reactions and the basic principles involved. A number of chapters have been expanded because of the declassification of literature in the field. (R. Stephenson. Toronto, McGraw-Hill, 1958. 491p., $11.40.)

ENGINEERING MATHEMATICS

An undergraduate textbook for engineers, intended to show the usefulness of mathematics and its applications in engineering. The author has developed the text from a course he gave at Iowa State College, in which differential equations and other topics were treated on the same level. The first chapter covers linear differential equations. Later chapters cover other types, the separation of variables method for solving boundary value problems, matrices and vectors, numerical methods, vector analysis and operational analysis. Many worked examples and problems and answers are included. (R. E. Gaskell. Toronto, Macmillan, 1958. 462p., $7.25.)

MECHANICS APPLIED TO ENGINEERING

Intended for those students with very little knowledge of engineering, this volume concentrates on the basic principles of mechanics, showing their application to as many fields of engineering as possible. The material is divided into statics and dynamics and there are many worked examples and problems and answers. (G. H. Ryder. London, Cleaver-Hume, 1958. 244p., 21/-.)

AIR AND WATER POLLUTION IN THE IRON AND STEEL INDUSTRY

The Proceedings of two conferences held in London in 1957 under the sponsorship of The Iron and Steel Institute. At the air pollution meeting the papers by experts from five countries covered the following topics: general and cost aspects of air pollution by the iron and steel industry; reducing air pollution from sinter plants and coke ovens; overseas experience in abating air pollution; treatment of fumes from arc furnaces; treatment of flue gases. The topics considered at the water pollution meeting were: general technical aspects of pollution of rivers; treatment of effluent from blast-furnace gas-cleaning plants and coke ovens; use of sewage effluent in steelworks, and reduction of effluent; processes for spent pickle liquor. This is a valuable contribution to the literature on this important subject. (London, Iron and Steel Institute, 1958. 259p., £4.5. Special report no. 61.)

*TOOLING FOR METAL POWDER PARTS

Stresses practical aspects of planning and tooling for structural parts such as cams, gears, and latches. Among the factors discussed are designing parts, methods of production and preparation of powders, briquetting techniques, design of briquetting tools, and the various finishing operations. The book was prepared under the direction of the American Society of Tool Engineers. (G. H. DeGroat. New York, American Society of Tool Engineers, 1958. 242p., $7.50.)

*SOUND PULSES

Describes the theory of sound pulses as based on the theory of linear partial differential equations of hyperbolic type. Aspects dealt with are the equations of motion, wavefronts and characteristics, geometrical acoustics and their application to reflection problems, and the diffraction of a pulse by a wedge, circular cylinder, sphere and other objects. (F. G. Friedlander. Toronto, Macmillan, 1958. 202p., $6.75.)

*BUILDING WITH TILT-UP, 2ND ED.

A field manual describing the various procedures utilized in this type of construction, including floor slab fabrication and crack control; wall panel fabrication; hot and cold weather concreting; wall footings and special foundations; point pick up; erection and bracing; joinery. This edition contains a special section on the custom modular framing method useful for special buildings such as schools. (F. T. Collins. San Gabriel, Calif., Know How Publications, 1958. 160p., $10.00.)

*DESIGN OF TILT-UP BUILDINGS

Provides the fundamental information necessary to good design practice for job

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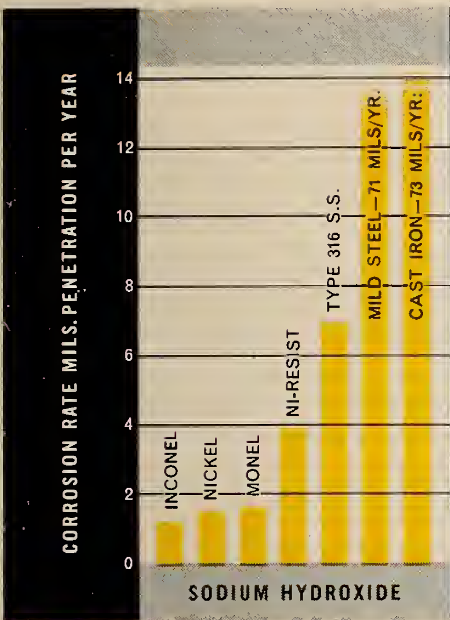
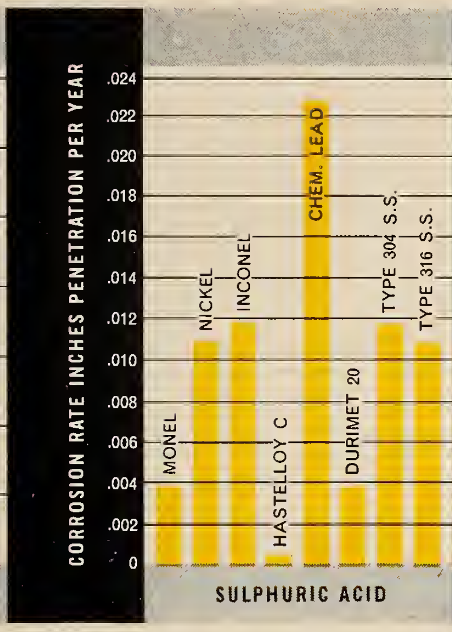
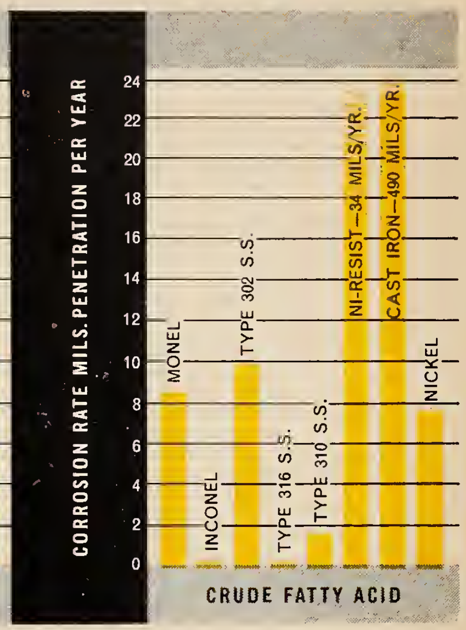


This test was conducted in a plant manufacturing caustic soda. The test spool carrying duplicate specimens of each of the metals shown above was immersed in a solution of 75% sodium hydroxide at a temperature of 275°F. for 35 days.



Plant test in sulphation of vegetable oils with 66° Baumé sulphuric acid and an acid-to-oil ratio of 20-25% by weight at temperatures ranging from 68°F. to 140°F. for a period of 7 days.

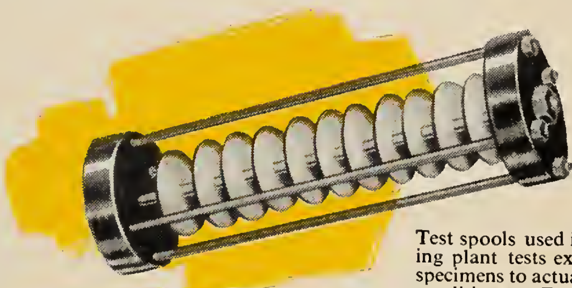


Plant test in distillation of crude fatty acid (cottonseed). Corrosion test spool was located at top of the batch still near the vapour outlet for 42 days. Temperature 480°-520°F.

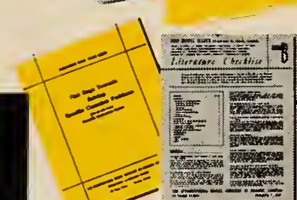
The graphs above show you what can happen—and may be happening—to equipment handling acids or caustics in your plant, if you're not using the right material for the job. And they're only examples from more than 300,000 similar tests Inco has conducted in a wide range of acids, alkalies, organic compounds and other environments.

The results of these tests have been carefully documented and are available from Inco to help you select the right metal for your corrosive applications. If your corrosion problem has not been covered by these tests, Inco's research and development engineers will undertake to find a solution for you without cost. Just outline your problem on a Corrosion Data Work Sheet, also available from Inco.

Use the coupon at right to order List "B", itemizing Inco publications dealing with corrosion, and the Corrosion Data Work Sheet.



Test spools used in conducting plant tests expose metal specimens to actual corrosive conditions. Evaluation of corrosive damage is made in Inco laboratories.



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EJMP-6

site prefabrication. Gives data on lateral force resistance, roof framing, columns, wall panels, pick up analysis, concrete floor slabs, footings and foundations, and joinery. (F. T. Collins. San Gabriel, Calif., Know How Publications, 1957. 162p., $12.50.)

MANUAL OF TILT-UP CONSTRUCTION, 4TH ED.

After a brief review of the history of tilt up construction, the following topics are covered: flat cast versus thin shell construction; patents in tilt up; casting surfaces and molds; bond breaking; painting precast concrete; construction schedule; field layout; forms; panel fabrication; joinery; erection; costs; sandwich type panel construction; bibliography. (F. T. Collins. San Gabriel, Calif., The Author, 1955. 101p., $12.50.)

*INFORMATION AND COMMUNICATION PRACTICE IN INDUSTRY

Intended as a comprehensive view of the subject, this volume considers technical writing, editing, and illustrating; classification; information services and their part in internal communications; operations research; patent collections; research files; punched cards; training the literature scientist; translating; indexing and abstracting. (Ed. by T. E. R. Singer. New York, Reinhold, 1958. 304p., $8.75.)

FRASER'S CANADIAN TRADE DIRECTORY, 1958

More than 12,500 firms are included in the alphabetical listing in this 1958 edition, and their products classified under some 6,500 product headings. More than 15,000 brand and trade names and trade marks are listed, as are the Canadian representatives of over 12,000 foreign companies. The market data section contains information for companies interested in foreign trade, Canadian cities and towns with a population of over 1,500, transportation companies, utilities, banks and telephone and telegraph companies. This is an indispensable volume. (Montreal, Fraser's Trade Directories, 1958. 1872p., $10.00.)

*COMPOSITE CONSTRUCTION IN STEEL AND CONCRETE FOR BRIDGES AND BUILDINGS

The fundamentals of composite construction are given, including design equations and procedures, methods of connecting slabs to beams, and illustrative examples of design procedures. Special features include a rapid method for the composite design of beams, and design methods for the three most commonly used shear connectors; studs, flexible channels, and spirals. (I. M. Viest. Toronto, McGraw-Hill, 1958. 176p., $8.65.)

CONCRETE FOR RADIATION SHIELDING

The seven papers in this compilation previously appeared in the Journal of the American Concrete Institute. They are concerned with the use of concrete for shielding nuclear radiation, and the calculation of proportions and properties of various heavy concretes. (Detroit, American Concrete Institute. 132p., $4.00.)

GLASS-MELTING TANK FURNACES

Much research has been done in Germany in the last thirty years on the production of glass, and in this volume translated from the 1954 German edition the latest systems of operation and methods of construction of tank furnaces are discussed. The topics covered are: types of furnace; operation; construction details; heat recovery; control of gaseous flow; control equipment; heating and cooling the furnace; furnace capacity and fuel efficiency; fundamental thermal calculations; history of the tank furnace. In this translation, in addition to several minor changes, the text has been rearranged and divided into eleven chapters, the units of measurement have been changed from the C.G.S. to the F.P.S. system, and the number of references has been doubled. (Rudolf Gunther. Sheffield, Society of Glass Technology, 1958. 232p., £3.)

LES ONDES CENTIMETRIQUES

Since the advent of Radar, much research has been done in the field of very short electromagnetic waves. The majority of the texts has been written in English, this is one of the few French books on the subject. The topics covered include propagation, impedance, wave measurements, measurement of dielectric constants, high frequency generators, detectors, antennas, and application in radio astronomy. The book is intended as an undergraduate text. (G. Raoult. Paris, Masson, 1958. 401p., 6500 fr.)

INTRODUCTION A L'ANALYSE DIMENSIONNELLE ET AUX PROBLEMES DE SIMILITUDE EN MECANIQUE DES FLUIDES

The first section of this volume contains a discussion of dimensional analysis and its many applications. The second section deals with the simulation of river conditions in scale models and its attendant problems. The final section disucusses applications: study of hydraulic turbomachines, cavitation phenomena; speed of flow by a wall; and distortion in river models. R. Comolet. Paris, Masson, 1958. 116p., 1600 fr.)

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Architecture

Onze cents années d'architecture en Tchécoslovaquie, by V. Mencl. Prague, Administration des Monuments Historiques, 1957.

Atomic energy

The story of the atom, by Sir J. Cockcroft. London, H.M.S.O., 1958.
Status and prospects of nuclear power; an interim survey. New York, Edison Electric, 1958. (EEI no. 58-13) $2.50.

• LIBRARY NOTES

Cement and concrete

Cement-aggregate reaction in concrete of a Canadian bridge, by E. G. Swenson. Ottawa, N.R.C., 1958. (Div. of Bldg. Research paper no. 59) 25c.

Danish National Institute of Building Research, Committee on alkali reactions in concrete. Progress reports:
H1: Evaluation of alkali reactions in concrete by the chemical test, by K. E. H. Christensen.

Electrical engineering

Electrical Research Association: Technical reports: L/T 351—The electrical properties of tungsten trioxide, by J. Hirsch. Y/T 21: Failures of domestic immersion heaters caused by corrosion and scale formation—resume of literature and assessment of economic importance in Great Britain, by A. M. Thomas. G/T 311: The temperature rise of the terminals of plugs and socket outlets to B.S.1363: 1947, with special reference to adaptors, by H. W. Baxter. O/T 19: The movement of an arc between parallel horizontal rods fed from one end in still air and in a wind, by A. E. Guile. Z/T 112: Arc and bead characteristics for pure aluminum for a range of wire feed rates (self-adjusting arc) at a constant voltage in argon, by J. C. Needham and A. A. Smith. C/T 120: Windmills for electricity supply in remote areas, by G. Gimpel and A. H. Stodhart. F/T 186: Methods for the calculation of cyclic rating factors and emergency loading for cables laid direct in the ground or in ducts, by H. Goldenberg.

E.R.A. Overseas newsletter. v.1.n.1., 1958.

Ground temperatures

Ground temperature studies at Saskatoon and Ottawa, Canada, by D. C. Pearce. Ottawa, N.R.C., 1958. (Div. of Bldg. Research paper no. 64) 25c.

Heat transmission

Calculation of the thermal conductivity of porous media, by W. Woodside. Ottawa, N.R.C., 1958. (Div. of Bldg. Research paper no. 56).

Metals and alloys

Metal products from Holland, by the Association of metal-working industries. The Hague, 1958.

Le travail des métaux sans enlèvement de copeaux; numéro spécial de La Technique Moderne, June, 1958.

Permafrost

Selected bibliography on Canadian permafrost; annotations and abstracts, by F. A. Cook. Canada, Dept. of Mines and Technical Surveys Geographical Branch, 1958. (Bibliographical Series no. 20).

Pipe lines. Concrete

Recommended practice for selection and installation of concrete pipe conduits. Toronto, Ontario Concrete Pipe Association, 1958.

Snow and ice

Ice conditions in the Gulf of St. Lawrence during the spring seasons 1953-1957, by C. N. Forward. Canada, Dept. of Mines and Technical Surveys Geographical Branch, 1958. (Geographical paper no. 16)

Influence of snow cover on heat flow from the ground, by L. W. Gold. Ottawa, N.R.C., 1958. (Div. of Bldg. Research paper no. 63) 10c.

Variability of physical characteristics of snow cover across Canada, by G. P. Williams. Ottawa N.R.C., 1958. (Div. of Bldg. Research paper no. 62).

Stone

Choix et assemblage des élements de maçonnerie en vue de leur résistance aux intempéries, by T. Ritchie and W. G. Plewes. Ottawa, N.R.C., 1958. (Div. of Bldg. Research Technical paper no. 30).

Sulphur dioxide

The measurement of atmospheric sulphur dioxide and chlorides, by M. R. Foran, E. V. Gibbons, and J. R. Wellington. Ottawa, N.R.C., 1958. (Div. of Bldg. Research paper no. 61).

Annual reports

Annual report of the Board of Regents of the Smithsonian Institution, 1957. Washington, G.P.O., 1958.

STANDARDS RECEIVED

ASTM standards. American Society Testing Materials, 1916 Race St., Pl dephia 3, Pa.

Specifications and tests for electrodeposited metallic coatings. $2.25.

ASTM standards on gaseous fuels. $3.00.

Canadian standards. Canadian Standards Association, 235 Montreal Rd. Ottawa 2.

C22.2 No. 37-1958: Construction and test of Christmas-tree and other decorative lighting outfits, 2nd ed. $1.00.

C22 2 43-1958: Construction and test of lampholders having socket screwshells, 2nd ed. $1.50.

C22.2 No. 97-1958: Construction and test of outdoor and submersible floodlights. $1.00.

List of approved oil-burning equipment, 5th ed., 1958.

Canadian Underwriters' Association standards. Canadian Underwriters' Association, 460 St. John St., Montreal.

No. 10. Standard for the installation, maintenance and use of portable fire extinguishers.

Business and Industrial Briefs

A DIGEST OF INFORMATION RECEIVED BY THE EDITOR

Appointments and Transfers

Department of Defence Production — B. E. Poirier has recently been appointed executive assistant to the Hon. R. O'Hurley, minister of defence production.

Royalite Oil Company — Charles Hay, M.E.I.C., has been appointed president of Royalite Oil Company, Limited, Calgary. Following the retirement of C. U. Daniels, R. L. Thompson has been named a director. J. W. Whitaker becomes secretary, and D. J. Morrison treasurer of the company.

Canadian Westinghouse — J. D. Campbell has been elected to the newly created post of executive vice-president of the Canadian Westinghouse Company Limited, Hamilton, Ont.

Saguenay Electric — The following executive appointments have recently been announced by Saguenay Electric Company, an affiliate of Aluminum Company of Canada, Ltd.: P. Tellier has been named executive vice-president; G. Dufour, M.E.I.C., vice-president and general manager; P. Beaulieu and G. Proulx, M.E.I.C., vice-presidents.

P. Tellier

DOSCO Appointments — The Dominion Steel & Coal Corporation has announced the appointment of D. G. Scott as comptroller and A. A. Donaldson as assistant comptroller of the organization. E. L. Pursey is assistant to the vice-president, finance.

Rawhide Mfg. Co. of Canada — G. W. Barker has assumed the responsibilities of vice-president and general sales manager of the Chicago Rawhide Mfg. Co. of Canada Ltd., a division of Super Oil Seal Mfg. Co., Ltd., Brantford, Ont.

Ferranti-Packard—Ferranti-Packard Electric Limited have announced the following appointments to the newly formed marketing division of the firm. G. B. Hunnisett has been named manager, sales services. He will have co-ordinating engineers J. A. Pratt in Toronto, and G. R. Nayler, JR.E.I.C., in St. Catharines, directly assisting him. R. F. Taylor has become manager, marketing services. He will be assisted by R. J. Martin, manager, marketing research; R. M. Squires, product manager, transformers and electronics; R. T. James, product manager, metering equipment; E. A. Love, advertising manager. Headquarters for the marketing division will be in Toronto.

Also announced by Ferranti-Packard was the appointment of five district managers: J. H. McClennan, Quebec; R. C. Short, M.E.I.C., Ontario; D. A. McCuaig, M.E.I.C., Manitoba; T. C. Good, Alberta; L. B. Stacey, M.E.I.C., British Columbia.

Lenkurt Electric — C. W. Hunter has been appointed vice-president and general manager of Lenkurt Electric Co. of Canada, Ltd., Burnaby, B.C., effective January 1, 1959. He will succeed W. H. Heflin who has been named general manager of the commercial products division of Lenkurt Co., Inc., San Carlos, California.

Shawinigan Chemicals — Announcement has been made of the following appointments at Shawinigan Chemicals Limited: L. F. Fitzpatrick, sales manager, heavy chemicals division; A. E. Doig, sales manager, stainless steel and alloys division, J. P. Ogilvie, technical manager, stainless steel and alloys division.

G. B. Hunnisett

Joy Manufacturing Company — M.S. (Monte) Cranston has been appointed to the newly created post of assistant general sales manager, eastern division of Joy Manufacturing Company (Canada) Limited, Galt, Ont.; his headquarters will be in Montreal. Assisting him will be D. L. Larson.

Dominion Rubber Appointments — Dominion Rubber Company Limited, Montreal, has appointed N. W. Smith production manager of the mechanical goods division of the company. A. Beauchamp has been named factory manager to succeed Mr. Smith.

Canadian General Electric—J. R. Oakley has been appointed sales manager—semiconductor products, in Canadian General Electric Company Limited's tube section. G. E. Mean has been made application engineer.

Potter & Brumfield — A. Robinson has been made production manager of Potter & Brumfield Canada Limited, Guelph, Ont.

Honeywell Controls Limited — H. C. Sage has joined the commercial division sales of Honeywell Controls Limited, in the company's Winnipeg office.

Business News

Canadian Representative — John Hamilton is directing the activities in Canada of Simon-Carves Ltd., of Stockport, England. This company has opened offices at 670 Bayview Avenue, Toronto. In addition to representing the parent company, the following subsidiaries will also be represented; Huntingdon, Heberlein & Co. Ltd., and Chemical Engineering Wiltons Ltd.

This newly formed organization will be of particular interest to those who are concerned with colliery and mining engineering (winding and surface plant); coal preparation plants; water-tube boilers and complete power stations; sulfuric acid and other chemical plants; electro-precipitators for industrial mists and dusts; continuous sintering plants; ore preparation and concentration plants; metallurgical and chemical roasting furnaces; etc.

Permali Expansion — Permali (Canada) Limited have recently purchased the building at 137 Kipling Avenue South, Toronto, part of which they previously held under lease. Due to increased business in the fabrication of insulating components from their densified wood laminate for the heavy electrical industry, the whole building will now be used with improvements made in existing facilities. In addition, the manufacture of other insulating materials is being commenced. Permali (Canada) Limited are also sole Canadian agents for Steatite and Porcelain Products, Worcester, England.

GM Diesels for Ceylon — Ceylon was the recipient of two additional Diesel-electric locomotives recently. The two units bring to ten the number of locomotives donated to Ceylon by Canada under the Colombo Plan. Built by General Motors Diesel Limited, London, Ont., each locomotive has been named after a Canadian province by officials of the Ceylon Government Railway and each bears a designating plaque. The last two units bear the names of Prince Edward Island and Newfoundland. Known as the Model G-12, the locomotives are of a type designed by General Motors for universal application on the world's railways. They have 2-motor, three axle trucks designed for the 66-inch broad gauge track in Ceylon. These A-1-A fully flexible trucks are used to reduce axle loading.

C-I-L Sales Office — Canadian Industries Limited, Montreal, has begun construction of a new consolidated sales office at 4606-1st St. S.E., in Calgary, according to an announcement by company officials. It will be located on the same site now occupied by its consolidated warehouse. The $70,000 one-storey building will house the Calgary sales staffs of the company's paints, chemicals, explosives and ammunition divisions now located at 1029-11th Ave. W. The building contract has been awarded to the

• BRIEFS

Poole Construction Co. Ltd., of Calgary. Completion of the building is scheduled for May, 1959.

Plastics Distributor — The appointment of Plastics Maritime Limited, Halifax, as distributor for vibrin polyester resins in the Atlantic Provinces has been announced by the Naugatuck Chemicals Division of Dominion Rubber Company Limited, Montreal. Plastics Maritime Limited was incorporated in 1946 by G. L. Alguire, and since that time has expanded into the leading plastics material supply house in its region. Reinforced plastics are the fastest growing segment of the plastics industry in the Atlantic area, the company reports. In part this is due to the importance of fisheries in the Maritime economy, where reinforced plastic can play such an important role in the fabrication or covering of boats and in the manufacture of fish processing equipment. Plastics Maritime Limited will maintain distribution and service from their offices and plant at 58 Gerrish Street, Halifax, N.S.

New Division — The Bristol Aeroplane Company of Canada Limited has announced that its subsidiary, Bristol Aero Engines Limited of Montreal North, has formed an Aviation Services Division. This newly formed division is now functioning at Montreal Airport, Dorval, and is designed to perform aircraft ramp handling and maintenance services on behalf of scheduled and non-scheduled carriers.

Submarine Cable Contracts — Standard Telephones and Cables Limited of England have recently obtained two of the biggest submarine telecommunication contracts ever placed. The first — an order for 530 nautical miles of undersea cable and submerged repeaters for the Anglo-Swedish cable project — will provide the first direct telephone link between Britain and Sweden and is valued at £1¼ million. It will be the longest submarine telephone cable in Europe. The second order is for over 700 nautical miles of deep sea cable, part of a new 36 channel telephone system to be installed next year between Miami, Florida, and San Juan, Puerto Rico. Value of the contract is 2½ million dollars.

New Winnipeg Plant — Dominion Structural Steel Limited, Montreal, has begun construction of a new structural steel fabricating plant in the Winnipeg-St. Boniface area. Building and crane runway footings will be installed this fall on a 17 acre site, and construction of buildings will proceed throughout the winter and spring of 1959. The plant will be designed to permit anticipated expansion. Easy access to road and rail transportation has been arranged. Modern fabricating equipment will be included for cutting, punching, shearing, drilling, welding, rivetting, painting and erection of steel and steel products. Reinforcing steel and a wide range of warehouse stock will be available.

● BRIEFS

Quebec Distributor — Chaseside Equipment Company of Canada, Burlington, Ont. has announced the appointment of Laurion Equipment Ltd. as sole distributors for their line of tractor-shovels, dumpers and diesel power units in the province of Quebec.

Canadian Company — The formation of a Canadian company to manufacture and distribute Tapecoat protective coal tar coatings in tape form to Canadian gas, oil and industrial users has just been announced by The Tapecoat Company of Evanston, Ill. Known as The Tapecoat Company of Canada, Ltd., the new corporation has its offices and manufacturing facilities in a 5000 sq.-ft. plant at 25 Haas Road, Rexdale, Ont. J. R. Wall, formerly New York district manager for Tapecoat, is president of the Canadian corporation. Serving with him as a member of the board is A. S. Kingsmill of Tilley, Carson, McCrimmon and Wedd, solicitors of Toronto.

Public Works Contracts — Contracts involving expenditures totalling $15,086,831.31 were awarded by the Federal Department of Public Works during the month of July 1958, compared with $10,080,352.33 during the month of August 1958.

The amount for new works in building, construction and harbours and rivers engineering was $6,108,285.15 for July, and $2,429,363.07 for August; for the repair and maintenance of existing structures $975,768.70 for July, and $387,855.45 for August; for construction of Trans-Canada Highway roads through National Parks and other projects for July, $6.504,716.86 and for August $7,204,883.81; for dredging during the month of July $1,498,060.60, and during the month of August $58,250.00.

New Equipment and Developments

Twin Hoist Gantry Crane — Dominion Structural Steel Limited, Montreal, has reported that the section of Montreal's Metropolitan Boulevard Highway building project under Miron Stirling Walsh moves ahead at a rapid pace with this 12 ton Taymar Construction gantry crane. Designed and built by Dominion Structural Steel, in close co-operation with Miron Stirling Walsh, Engineers, the gantry crane has dual 6 ton hoists on a 125′ span which straddles the elevated highway. It is designed as a self-propelled machine for lifting and placing concrete and reinforcing steel from trucks under the cantilivered bridge on either or both sides of the highway. Motors for each motion draw energy from the diesel electric generator set carried on one end truck between the gantry legs, which also serve as fuel tanks. From the girder top 42′ above the rails the lifting speed is 60′ per minute for each hook. The trolleys move across the bridge at 140′ per minute, and the structure travels at 25′ per minute, reports Dominion Structural Steel.

Low-Odor, Fast-Curing Catalyst — A new catalyst for urethane polymers, N,N,N',N'-Tetramethyl-1,3-butanediamine, is available from Carbide Chemicals Company, Division of Union Carbide Canada Limited, Toronto. The new chemical is a colorless, stable fluid that is completely soluble in water and common organic solvents. This new amine is more reactive than the urethane catalysts systems commonly used, permitting faster during of urethane foams. Also, tetramethyl butanediamine is said to have an exceptionally low odor level, and yields soft, pliable foams. Tetramethyl butanediamine may also be a valuable catalyst for curing epoxy resins.

Sandvik Coromant Drill Steels — Atlas Copco Canada Limited, Montreal, has announced the introduction of Sandvik Coromant cold rolled extension drill steels for air track equipment and large-size drills. The new steels come with 1½ in. diameter in lengths of 10 and 8 ft., and with 2 in diameter in lengths of 10 and 20 ft. The company states that the new steels, designed for deeper hole drilling, feature the patented "rope thread" which simplifies uncoupling even after sustained drilling. Its rounded form is reported to reduce thread and coupling failures frequently found in reverse buttress or "saw tooth" threads. An advantage of the cold rolling process is that steels are given a tough core with hard surface, making it possible to re-thread them on ordinary metal lathes without heat treatment. A special feature of the new steel is represented by the large diameter flushing holes, which permits faster cleaning of drill holes, increases the penetration rate and gives a longer life to the steels and bits.

Space Heating — A new method of heating local, irregular or insufficiently insulated working areas has been announced by Canadian General Electric Co. Ltd., Toronto. By suspending radiant calrod panels from above, adequate warmth for complete working comfort can be radiated on to machine operators, etc. in large plants normally uneconomical to heat by usual methods. Radiant calrod panels transfer heat instantaneously, require practically no maintenance, and have relatively low operating costs. Panels are available in 6, 8, and 10 k.w. ratings, and 220, 440 or 550 volts.

Subminiature Electronic Switch — A new subminiature Haydon switch has been announced by Philips Electronics Industries Ltd., Toronto. The switch, Type 5366, is said to be qualified to MS25085 with operation up to a temperature of 400°F and a rated load of 5 amps., resistive and 3 amps. inductive. Mechanical life of 1,000,000 cycles, and 100,000 operations under rated load, are further features available. Philips Electronics state that this subminiature switch is designed to meet the strict specifications of aircraft and missile industries, requiring operation of switch assemblies under extreme temperatures.

Crane and Shovel Carrier — Sicard, Incorporated of Montreal state that a new 35 ton crane and shovel carrier has been added to the Sicard line of heavy equipment. Incorporating proven engineering advances, the Sicard model C-6435 combines welded, one-piece, torsion proof frame, low weight and complete stability. A choice of either gas or diesel engines provides traction on all wheels or on tandem wheels only. Two types of axles are available, Timken or Clark with double reduction or planetary drive. A few of the main features of this carrier are new featherweight magnesium outrigger floats; Fuller transmissions giving up to 15 speeds forward, and positive acting Bendix-Westinghouse air brakes.

Napanee Largest Press Brake — Announcement has been made of a major step forward in modern Canadian manufacturing has been taken by Napanee Iron Works, Napanee, Ont., a division of the International Equipment Co. Ltd., Montreal. Napanee reports it has recently added to its facilities the largest mechanical press brake in Canada, 1400 tons in capacity, capable of bending mild steel plate with dimensions of 1½" x 12′ or 1" x 17′. The size and capacity of the press is said to naturally lend itself to the production of custom forming of steel sections not normally produced by Canadian steel mills. Other production items would be highway safety fence, latticed bridge flooring, railway freight car doors, roofs and ends. Pressings on another components requiring high capacity forming or pressings at extreme lengths. At the present time the machine is being used for the production of nailable steel flooring which is used to replace old style wood flooring in railway freight car rolling stock, a modern answer to an old railroad problem of continuous maintenance.

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architects: PRACK & PRACK

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TIME DEFYING STAINLESS

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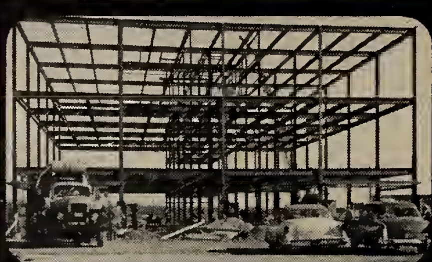
Our architectural development department is available for consultation on new and existing applications of stainless. Simply contact your nearest Atlas representative.

Ground broken, October 8th, 1957



Steel erected by November 6, 1957

Panels stored within structure